ABB industrial drives

Hardware manual
ACS880-01 drives
(0.55 to 250 kW, 0.75 to 350 hp)

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List of related manuals

Drive hardware manuals and guides	Code (English)
ACS880-01 hardware manual	*3AUA0000078093*
ACS880-01 quick installation guide for frames R1 to R3	*3AUA0000085966*
ACS880-01 quick installation guide for frames R4 and R5	*3AUA0000099663*
ACS880-01 quick installation guide for frames R6 to R9	*3AUA0000099689*
ACS880-01 assembly drawing for cable entry boxes of IP21 frames R5 to R9	*3AUA0000119627*
ACS-AP assistant control panels user's manual	*3AUA0000085685*

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	*3AUA0000085967*
Quick start-up guide for ACS880 drives with primary control program	*3AUA0000098062*

Option manuals and quides	
Manuals and quick guides for I/O extension modules, fieldbus adapters, etc.	

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

The QR code below opens an online listing of the manuals applicable to this product.

Hardware manual

ACS880-01 drives
(0.55 to 250 kW, 0.75 to 350 hp)

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1

Safety instructions

What this chapter contains

This chapter contains the safety instructions which you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, motor or driven equipment. Read the safety instructions before you work on the unit.

Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment and advise on how to avoid the danger. The following warning symbols are used in this manual:

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.
General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.
Electrostatic sensitive devices warning warns of electrostatic discharge which can damage the equipment.

Safety in installation and maintenance

Electrical safety

These warnings are intended for all who work on the drive, motor cable or motor.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Only qualified electricians are allowed to install and maintain the drive.
- Never work on the drive, motor cable or motor when main power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.

  Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:
  - voltage between drive input phases L1, L2 and L3 and the frame is close to 0 V
  - voltage between terminals UDC+ and UDC- and the frame is close to 0 V.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the drive even when the main power on the drive is switched off.
- Do not make any insulation or voltage withstand tests on the drive.
- Do not connect the drive to a voltage higher than what is marked on the type designation label. Higher voltage can activate the brake chopper and lead to brake resistor overload, or activate the overvoltage controller what can lead to motor rushing to maximum speed.

Note:

- The motor cable terminals on the drive are at a dangerously high voltage when the input power is on, regardless of whether the motor is running or not.
- The DC terminals (UDC+, UDC-) carry a dangerous DC voltage (over 500 V) when internally connected to the intermediate DC circuit.
- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of relay outputs (XRO1, XRO2 and XRO3).
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is ineffective against deliberate sabotage or misuse.

Grounding

These instructions are intended for all who are responsible for the grounding of the drive.

WARNING! Ignoring the following instructions can cause physical injury, death, increased electromagnetic interference and equipment malfunction:

- Ground the drive, motor and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.
- In a multiple-drive installation, connect each drive separately to protective earth (PE).
- Where EMC emissions must be minimized, make a 360° high frequency grounding of cable entries in order to suppress electromagnetic disturbances. In addition, connect the cable shields to protective earth (PE) in order to meet safety regulations.
- Do not install a drive with EMC filter option +E200 or +E202 on an ungrounded power system or a high-resistance-grounded (over 30 ohms) power system.

Note:

- Power cable shields are suitable for equipment grounding conductors only when adequately sized to meet safety regulations.
- Standard EN 61800-5-1 (section 4.3.5.5.2.) requires that as the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth connection and
  - a cross-section of the protective earthing conductor of at least 10 mm^2 Cu or 16 mm^2 Al,

  or
  - automatic disconnection of the supply in case of discontinuity of the protective earthing conductor,

  or
  - a second protective earthing conductor of the same cross-sectional area as the original protective earthing conductor.

  Frames R1 to R3 provide two terminals for the protective earthing conductors if a brake resistor is not connected. See page *85*.

Permanent magnet motor drives

These are additional warnings concerning permanent magnet motor drives.

WARNING! Ignoring the instructions can cause physical injury or death, or damage to the equipment:

- Do not work on the drive when the permanent magnet motor is rotating. Also, when the supply power is switched off and the inverter is stopped, a rotating permanent magnet motor feeds power to the intermediate circuit of the drive and the supply connections become live.

Before installation and maintenance work on the drive:

- Stop the motor.
- Ensure that there is no voltage on the drive power terminals according to step 1 or 2, or if possible, according to the both steps.

  1. Disconnect the motor from the drive with a safety switch or by other means. Check by measuring that there is no voltage present on the drive input or output terminals (L1, L2, L3, U/T1, V/T2, W/T3, UDC+, UDC-).

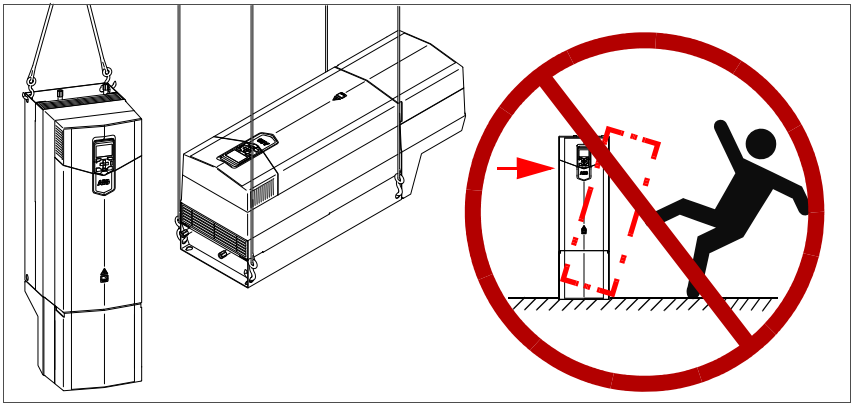
  2. Ensure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, is able to rotate the motor directly or through any mechanical connection like felt, nip, rope, etc. Check by measuring that there is no voltage present on the drive input or output terminals (L1, L2, L3, U/T1, V/T2, W/T3, UDC+, UDC-). Ground the drive output terminals temporarily by connecting them together as well as to the PE.

General safety

These instructions are intended for all who install and service the drive.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Handle the unit carefully.
- Frame sizes R6 to R9: Lift the drive using the lifting eyes of the unit. Do not tilt the drive. **The drive is heavy and its center of gravity is high. An overturning unit can cause physical injury.**



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Ensure that debris from borings and grindings does not enter the drive when installing. Electrically conductive debris inside the unit may cause damage or malfunction.
- Ensure sufficient cooling.
- Do not attach the drive by riveting or welding.

Printed circuit boards

WARNING! Ignoring the following instructions can cause damage to the printed circuit boards:

- Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily. The printed circuit boards contain components sensitive to electrostatic discharge.

Safe start-up and operation

General safety

These warnings are intended for all who plan the operation of the drive or operate the drive.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Before you connect voltage to the drive, make sure that the drive covers are on. Keep the covers on during the operation.
- Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the speed provided by connecting the motor directly to the power line.
- Do not activate any automatic fault reset functions of the drive control program if dangerous situations can occur. When activated, these functions will reset the drive and resume operation after a fault.
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.
- Make sure that any safety circuits (for example, emergency stop and Safe torque off) are validated in start-up. See chapter *Start-up* for reference of the validation instructions.

Note:

- If an external source for start command is selected and it is ON, the drive will start immediately after an input voltage break or fault reset unless the drive is configured for 3-wire (a pulse) start/stop.
- When the control location is not set to local, the stop key on the control panel will not stop the drive.

Permanent magnet motor drives

WARNING! Do not run the motor over the rated speed. Motor overspeed leads to overvoltage which may damage or explode the capacitors in the intermediate circuit of the drive.

2

Introduction to the manual

What this chapter contains

This chapter describes the manual. It contains a flowchart of steps for checking the delivery, installing and starting up the drive. The flowchart refers to chapters/sections in this manual and to other manuals.

Target audience

This manual is intended for people who plan the installation, install, start-up, use and service the drive. Read the manual before working on the drive. You are expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is written for readers worldwide. Both SI and imperial units are shown.

Contents of the manual

This manual contains the instructions and information for the basic drive configuration. The chapters of the manual are briefly described below.

Safety instructions gives safety instructions for the installation, start up, operation and maintenance of the drive.

Introduction to the manual introduces the manual.

Operation principle and hardware description describes the drive.

Mechanical installation describes how to install the basic drive mechanically.

Planning the electrical installation contains instructions for the motor and cable selection, protections and cable routing.

Electrical installation gives instructions on wiring the drive.

Installation checklist contains a list for checking the mechanical and electrical installation of the drive.

Start-up describes the start-up procedure of the drive.

Fault tracing describes the fault tracing of the drive.

Maintenance contains preventive maintenance instructions.

Technical data contains the technical specifications of the drive, eg, the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings.

Dimension drawings contains dimension drawings of the drives and auxiliary components.

Safe Torque off function describes the Safe torque off function of the drive and gives instructions on its implementing.

Resistor braking describes selection, protection and wiring of brake choppers and resistors. The chapter also contains technical data.

Common mode, du/dt and sine filters describes selection external filters for the drive.

Related manuals

See *List of related manuals* on the inside of the front cover.

Categorization by frame size and option code

The instructions, technical data and dimension drawings which concern only certain drive frame sizes are marked with the symbol of the frame size (R1, R2, etc.). The frame size is marked on the type designation label.

The instructions and technical data which concern only certain optional selections are marked with option codes (such as +E200). The options included in the drive can be identified from the option codes visible on the type designation label. The option selections are listed in section *Type designation key* on page *34*.

Quick installation, start-up and operating flowchart

Task	See
Plan the electrical installation and acquire the accessories needed (cables, fuses, etc.). Check the ratings, required cooling air flow, input power connection, compatibility of the motor, motor connection, and other technical data.	*Planning the electrical installation* (page *51*) *Technical data* (page *133*)
Check the installation site.	*Ambient conditions* (page *160*)
Unpack and examine the units (only intact units may be started up). Examine that all necessary optional modules and equipment are present and correct. Mount the drive.	*Mechanical installation* (page *39* or *41*) If the drive has been non-operational for more than one year, the converter DC link capacitors need to be reformed (page *130*)
Route the cables.	*Routing the cables* (page *68*)
Check the insulation of the supply cable, the motor and the motor cable.	*Checking the insulation of the assembly* (page *79*)
Connect the power cables. Connect the control cables.	*Connecting the power cables* (page *82*), *Connecting the control cables* (page *98*)
Check the installation.	*Installation checklist* (page *113*)
Start the drive up.	*Start-up* (page *115*)
Operate the drive: start, stop, speed control etc.	*ACS880 quick start-up guide,* firmware manual

Terms and abbreviations

Term/ Abbreviation	Explanation
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EMT	Electrical metallic tubing
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FCAN-01	Optional FCAN-01 CANopen adapter module
FCNA-01	Optional ControlNet™ adapter module
FDNA-01	Optional DeviceNet™ adapter module
FECA-01	Optional EtherCAT adapter module
FEPL-01	Optional Ethernet POWERLINK adapter module
FENA-01	Optional Ethernet/IP™ and Modbus/TCP and PROFINET adapter module
FENA-11	Optional dual port Ethernet/IP™ and Modbus/TCP and PROFINET adapter module
FLON-01	Optional LonWorks® adapter module
FPBA-01	Optional PROFIBUS DP adapter module
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional TTL absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FOA-01	Optional optical DDCS communication adapter module
FSO-11	Optional functional safety module
Frame (size)	Physical size of the drive
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in inverters due to their easy controllability and high switching frequency.
I/O	Input/Output
ZCON	Control board in which the control program runs.
ZCU	Control board built in a housing. The external I/O control signals are connected to the control unit, or optional I/O extensions mounted on it.
ZGAB	Brake chopper adapter board in frames R8 to R9
ZGAD	Gate driver adapter board in frames R6 to R9
ZINT	Main circuit board
ZMU	The memory unit attached to the control unit of the drive
R1…R9	Frame size designation of the drive
SAR	Safe acceleration range
SBC	Safe brake control

Term/ Abbreviation	Explanation
SLS	Safely-limited speed without encoder
SS1	Safe speed 1
SSE	Safe stop emergency
SMS	Safe minimum speed
STO	Safe torque off

Safety data (SIL, PL)

Abbr.	Reference	Description
CCF	EN/ISO 13849-1	Common cause failure (%)
DC	EN/ISO 13849-1	Diagnostic coverage
FIT	IEC 61508	Failure In time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
$MTTF_d$	EN/ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD	IEC 61508	Probability of failure on demand
PFH_d	IEC 61508	Probability of dangerous failures per hour
PL	EN/ISO 13849-1	Performance level: corresponds SIL, Levels a-e
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level
SILCL	EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
SS1	EN 61800-5-2	Safe stop 1
STO	EN 61800-5-2	Safe torque off
T1	IEC 61508	Proof test interval

3

Operation principle and hardware description

What this chapter contains

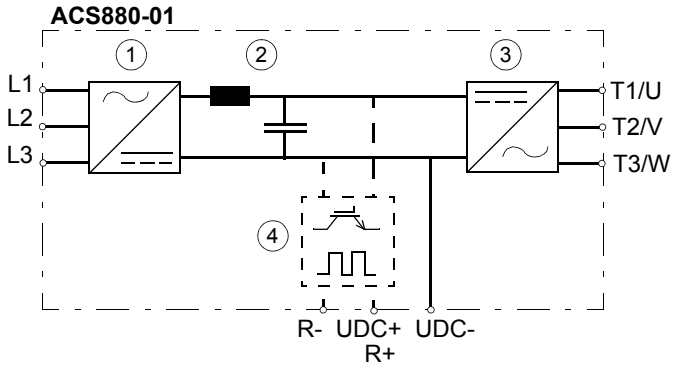
This chapter briefly describes the operation principle and construction of the drive.

Product overview

The ACS880-01 is a drive for controlling asynchronous AC induction motors, permanent magnet synchronous motors and AC induction servomotors.

Main circuit

The main circuit of the drive is shown below.



1	Rectifier. Converts alternating current and voltage to direct current and voltage.
2	DC link. DC circuit between rectifier and inverter.
3	Inverter. Converts direct current and voltage to alternating current and voltage.
4	Brake chopper. Conducts the surplus energy from the intermediate DC circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor. User obtains and installs the brake resistor when needed.

Layout (IP21, UL Type 1)

The components of the standard IP21 unit are shown below (view of frame R5).

	Description
1	Control panel
2	Front cover
3	Cable entry box
4	Four fastening points at the back of the unit
5	Heatsink
6	Lifting holes

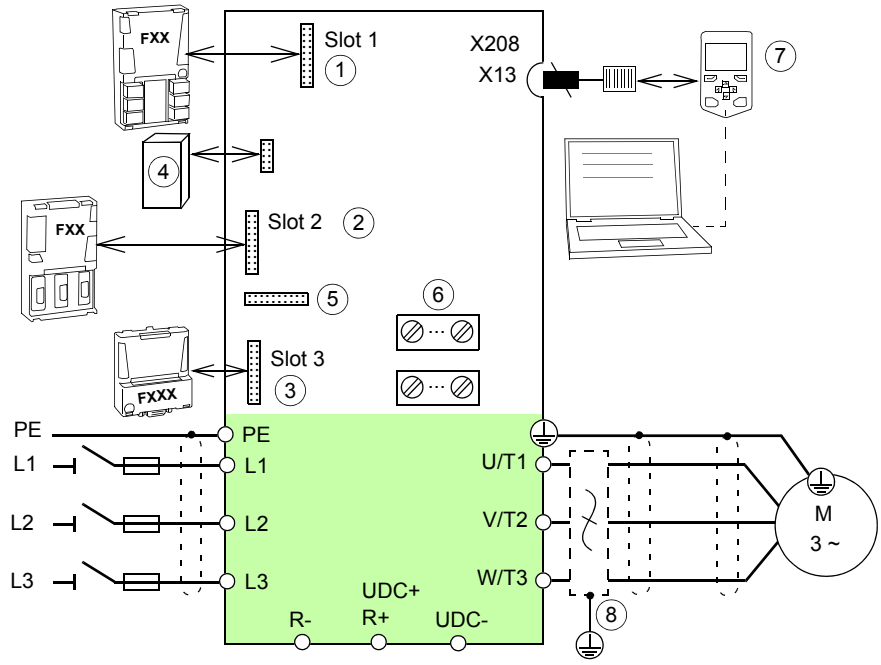
Layout (IP55, UL Type 12)

The components of the IP55 unit (option +B056) are shown below (view of frame R4).

	Description
1	Control panel behind the control panel cover
2	Front cover
3	Four fastening points at the back of the unit
4	Heatsink
5	Lifting holes

Overview of power and control connections

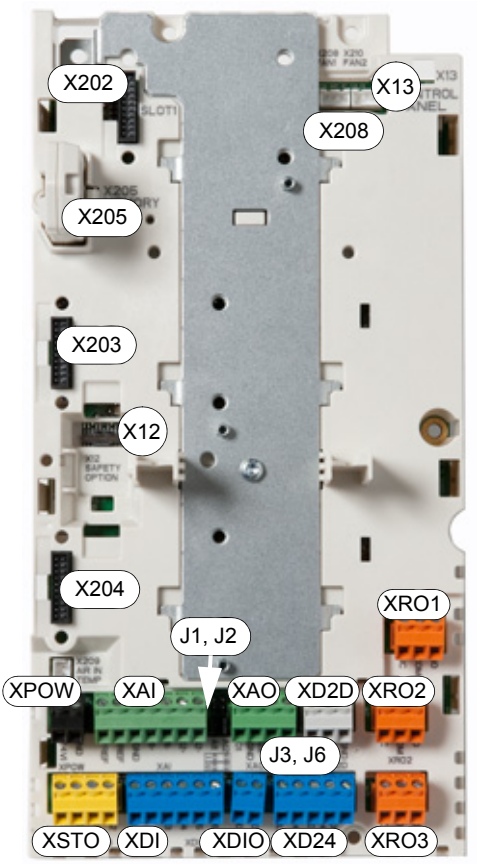
The diagram shows the power connections and control interfaces of the drive.



1 2 3	Option modules can be inserted into slots 1, 2 and 3 as follows: **Modules** — **Into slots** Analog and digital I/O extension modules except FDIO — 1, 2, 3 Feedback interface modules — 1, 2, 3 Fieldbus communication modules and FDIO — 1, 2 Safety functions modules — 2 See section *Type designation key*, page *34*
4	Memory unit, see page *131*.
5	Connector for safety functions modules (alternative to Slot 2)
6	See page *32*, *Default I/O connection diagram* (page *99*) and *Control unit/board (ZCU-11/ZCON-11) connection data* (page *157*).
7	See section *Control panel*, page *33*.
8	du/dt, common mode or sine filter (optional), see page *213*.

External control connection terminals

The layout of external control connection terminals of the drive is shown below.



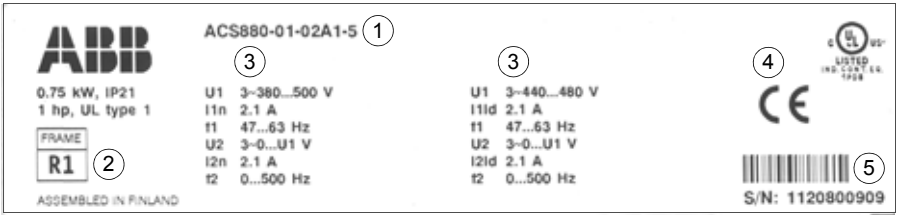
	Description
XPOW	External power input
XAI	Analog inputs
XAO	Analog outputs
XD2D	Drive-to-drive link
XRO1	Relay output 1
XRO2	Relay output 2
XRO3	Relay output 3
XD24	Start interlock connection (DIIL) and +24 V output
XDIO	Digital input/outputs
XDI	Digital inputs
XSTO	Safe torque off connection
X12	Connector for safety functions modules (optional)
X13	Control panel / PC connection
X202	Option slot 1
X203	Option slot 2
X204	Option slot 3
X205	Memory unit connection
X208	Auxiliary cooling fan connection
J1, J2	Voltage/Current selection jumpers (J1, J2) for analog inputs
J3, J6	Drive-to-drive link termination jumper (J3), common digital input ground selection jumper (J6)

Control panel

The control panel can be removed by pulling it forward from the top edge and reinstalled in reverse order. For the use of the control panel, see the firmware manual or *ACS-AP assistant control panels user's manual* (3AUA0000085685 [English]).

Type designation label

The type designation label includes an IEC and NEMA rating, appropriate markings, a type designation and a serial number, which allow identification of each unit. The type designation label is located on the front cover. An example label is shown below.



No.	Description
1	Type designation, see section *Type designation key* on page *34*.
2	Frame size
3	Ratings in the supply voltage range
4	Valid markings
5	Serial number. The first digit of the serial number refers to the manufacturing plant. The next four digits refer to the unit's manufacturing year and week, respectively. The remaining digits complete the serial number so that there are no two units with the same number.

Type designation key

The type designation contains information on the specifications and configuration of the drive. The first digits from left express the basic configuration, eg, ACS880-01-12A6-3 The optional selections are given thereafter, separated by plus signs, eg, +L519. The main selections are described below. Not all selections are available for all types. For more information, refer to *ACS880-01 Ordering Information* (3AXD10000014923), available on request.

CODE	DESCRIPTION
Basic codes	
ACS880	Product series
01	When no options are selected: Wall mounted drive, IP21 (UL Type 1), ACS-AP-I assistant control panel, no EMC filter, DC choke, ACS880 primary control program, Safe torque off function, cable entry box, brake chopper in frames R1 to R4, coated boards, printed multilingual quick guides and CD containing all manuals.
Size	
xxxx	Refer to the rating tables, page *134*
Voltage range	
2	208…240 V
3	380…415 V
5	380…500 V
7	525…690 V
Option codes (plus codes)	
Degree of protection	
B056	IP55 (UL Type 12)
Construction	
C131	Vibration dampers
Resistor braking	
D150	Brake chopper for frame R5 and up.
Filters	
E200	EMC filter for second environment TN (grounded) system, category C3.
E201	EMC filter for second environment IT (ungrounded) system, category C3. Available for 380…500 V frames R6 to R9.
E202	EMC filter for first environment TN (grounded) system, category C2.
Cable entry box	
H358	UK cable entry box
Fieldbus adapters	
K451	FDNA-01 DeviceNet™ adapter module
K452	FLON-01 LonWorks® adapter module
K454	FPBA-01 PROFIBUS DP adapter module
K457	FCAN-01 CANopen adapter module

CODE	DESCRIPTION
K458	FSCA-01 RS-485 adapter module
K462	FCNA-01 ControlNet™ adapter module
K469	FECA-01 EtherCAT adapter module
K470	FEPL-01 Ethernet POWERLINK adapter module
K473	FENA-11 high performance Ethernet/IP™, Modbus/TCP and PROFINET adapter module
I/O extensions and feedback interfaces	
L500	FIO-11 analog I/O extension module
L501	FIO-01 digital I/O extension module
L502	FEN-31 HTL incremental encoder interface module
L503	FDCO-01 optical DDCS communication adapter module
L508	FDCO-02 optical DDCS communication adapter module
L516	FEN-21 resolver interface module
L517	FEN-01 TTL incremental encoder interface module
L518	FEN-11 absolute encoder interface module
Specialties	
P904	Extended warranty
ATEX-certified function	
Q971	ATEX-certified Safe motor disconnection function using the Safe torque off function
Safety functions modules	
Q973	FSO-11 safety functions module
Full set of printed manuals in selected language. Note: The delivered manual set may include manuals in English if the translation is not available.	
R700	English
R701	German
R702	Italian
R703	Dutch
R704	Danish
R705	Swedish
R706	Finnish
R707	French
R708	Spanish
R709	Portuguese
R711	Russian
R712	Chinese
R713	Polish
R714	Turkish

4

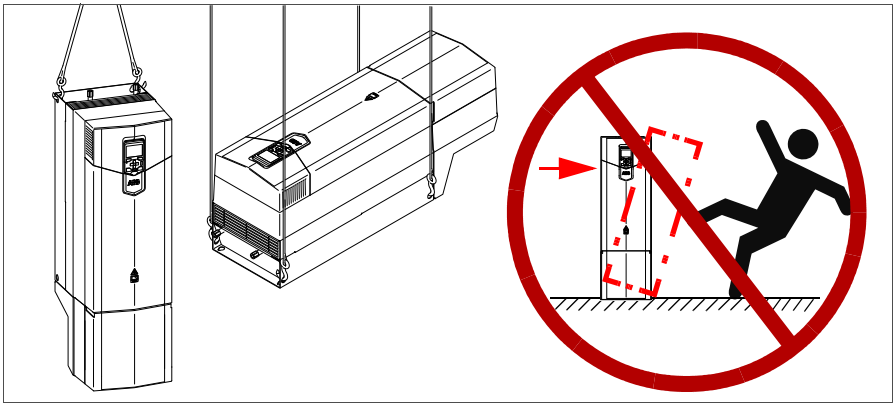
Mechanical installation

What this chapter contains

This chapter gives a description of the mechanical installation of the drive.

Safety

WARNING! For frame sizes R6 to R9: Use the lifting eyes of the drive when you lift the drive. Do not tilt the drive. **The drive is heavy and its center of gravity is high. An overturning drive can cause physical injury.**

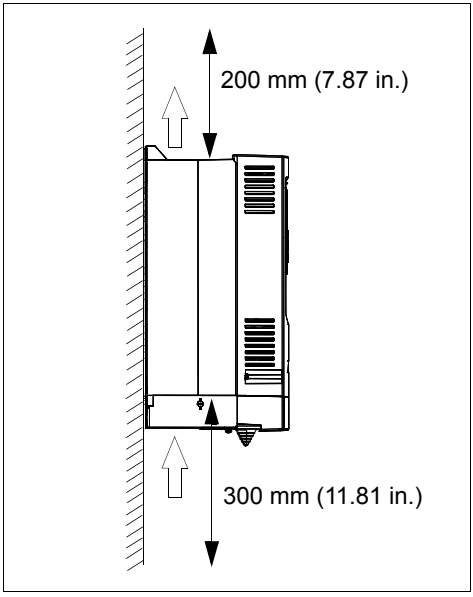


Examining the installation site

The drive must be installed in an upright position with the cooling section against a wall. All frames can be installed tightly side by side.

Make sure that the installation site agrees with these requirements:

- The installation site has sufficient ventilation to prevent overheating of the drive. See section *Losses, cooling data and noise* on page *150*.
- The operation conditions of the drive agree with the specifications in section *Ambient conditions* (page *160*).
- The wall is vertical, not flammable and strong enough to hold the weight of the drive. See page *149*.
- The material below the installation is not flammable.
- There is enough free space above and below the drive for cooling air flow, service and maintenance. See page *149*. There is enough free space in front of the drive for operation, service and maintenance.



Necessary tools

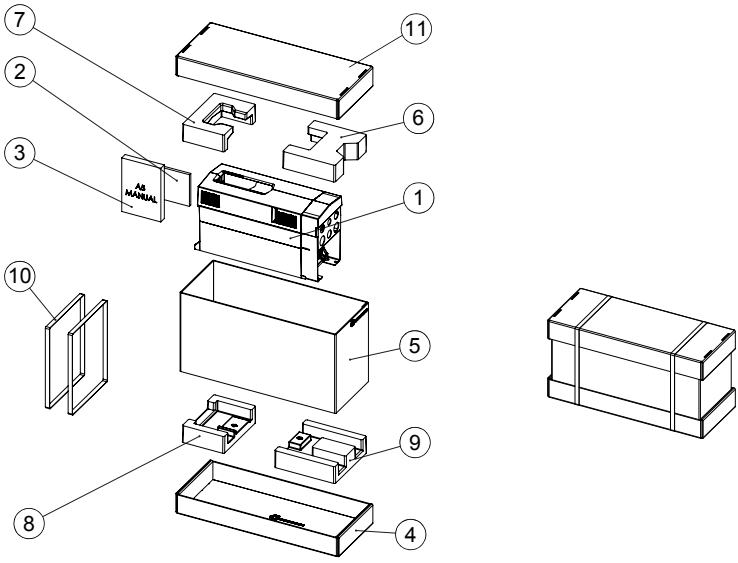
- Drill and drill bits
- Screwdriver and/or wrench with bits. The drive cover has Torx screws.

Moving the drive

Move the transport package by pallet truck to the installation site.

Upacking and examining the delivery (frames R1 to R5)

This illustration shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type.



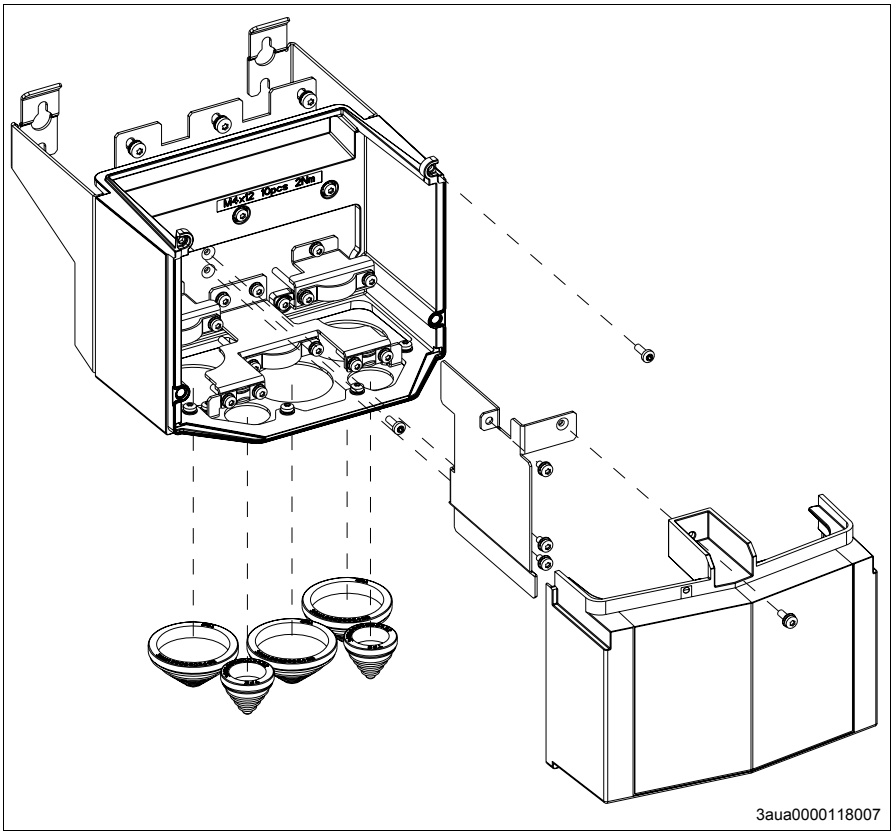
Item	Description	Item	Description
1	Drive with factory installed options. Control cable grounding shelf. Romex connectors in IP21 frames R1 to R3 in a plastic bag inside the cable entry box.	5	Cardboard sleeve
2	Manuals CD	6…9	Cushions
3	Printed quick guides and manuals, multilingual residual voltage warning sticker	10	PET straps
4	Cardboard tray	11	Top cardboard cover

To unpack:

- Cut the straps (10).
- Remove the top cardboard cover (11) and cushions (6…9).
- Lift the cardboard sleeve (5).
- Lift the drive.

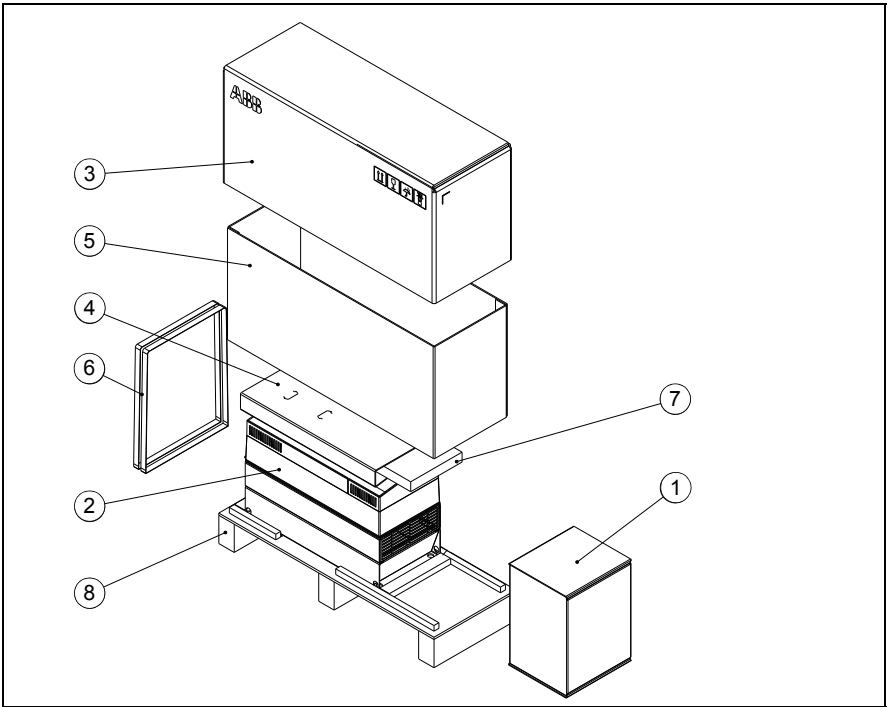
Frame R5 cable entry box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.



Upacking and examining the delivery (frames R6 to R9)

This illustration shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type.



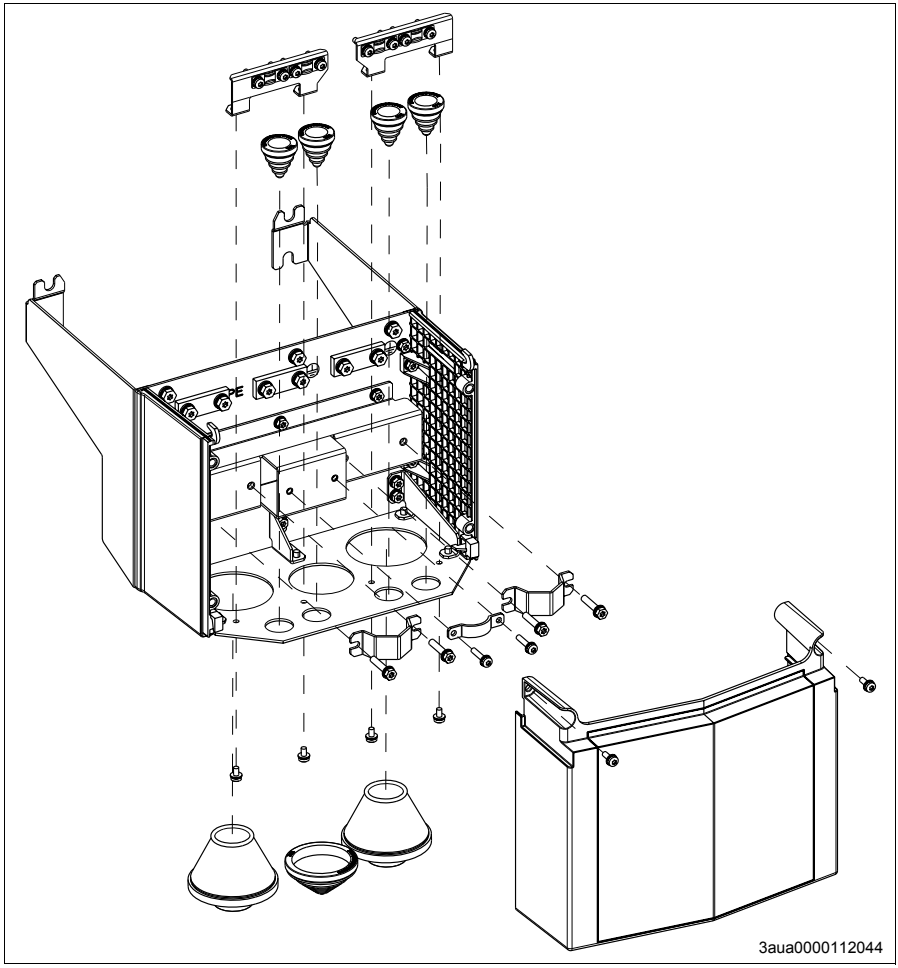
Item	Description	Item	Description
1	Cable entry box. Power and control cable grounding shelves in a plastic bag, assembly drawing. **Note**: The cable entry box is mounted to the IP55 drive module frame at the factory.	5	Cardboard sleeve
2	Drive with factory installed options	6	Straps
3	Top cardboard cover	7	Printed quick guides and manuals CD and multilingual residual voltage warning sticker
4	Cushion	8	Pallet tray

To unpack:

- Cut the straps (6).
- Remove the top cardboard cover (3) and cushion (4).
- Lift the cardboard sleeve (5).
- Attach lifting hooks to the lifting eyes of the drive. Lift the drive with a hoist.

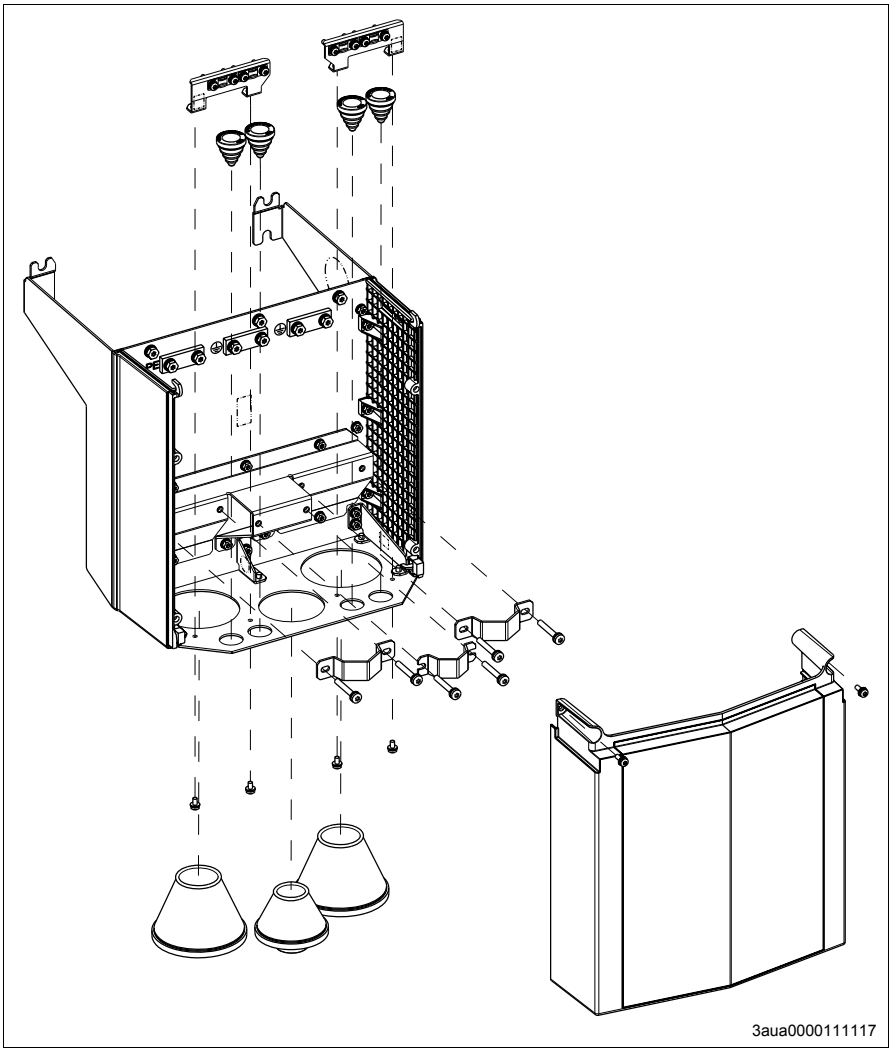
Frame R6 cable entry box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.



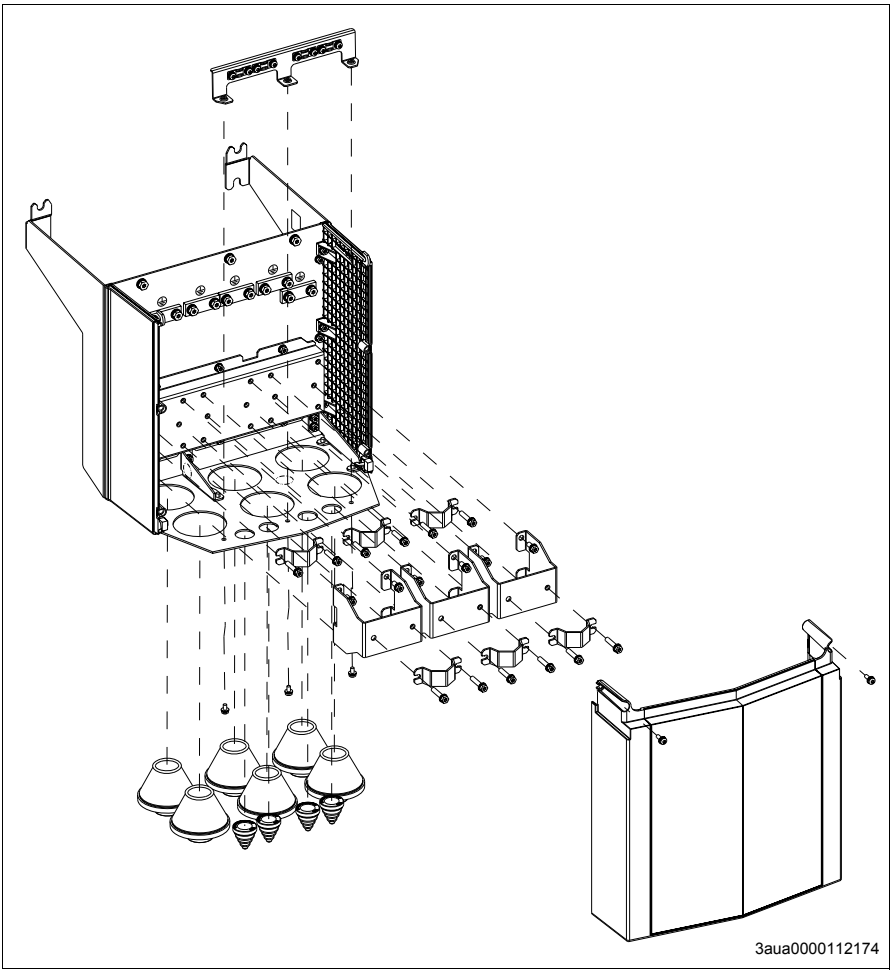
Frame R7 cable entry box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.



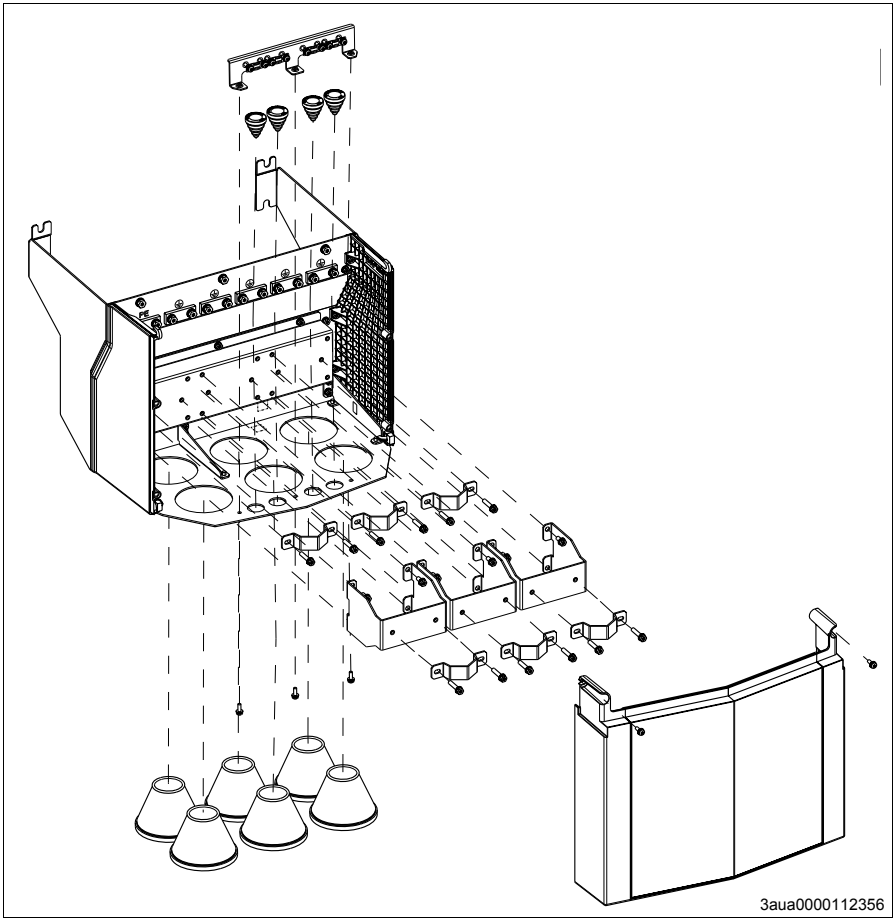
Frame R8 cable entry box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. There is also an assembly drawing which shows how to install the cable entry box to the drive module frame.



Frame R9 cable entry box (IP21, UL Type 1)

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.

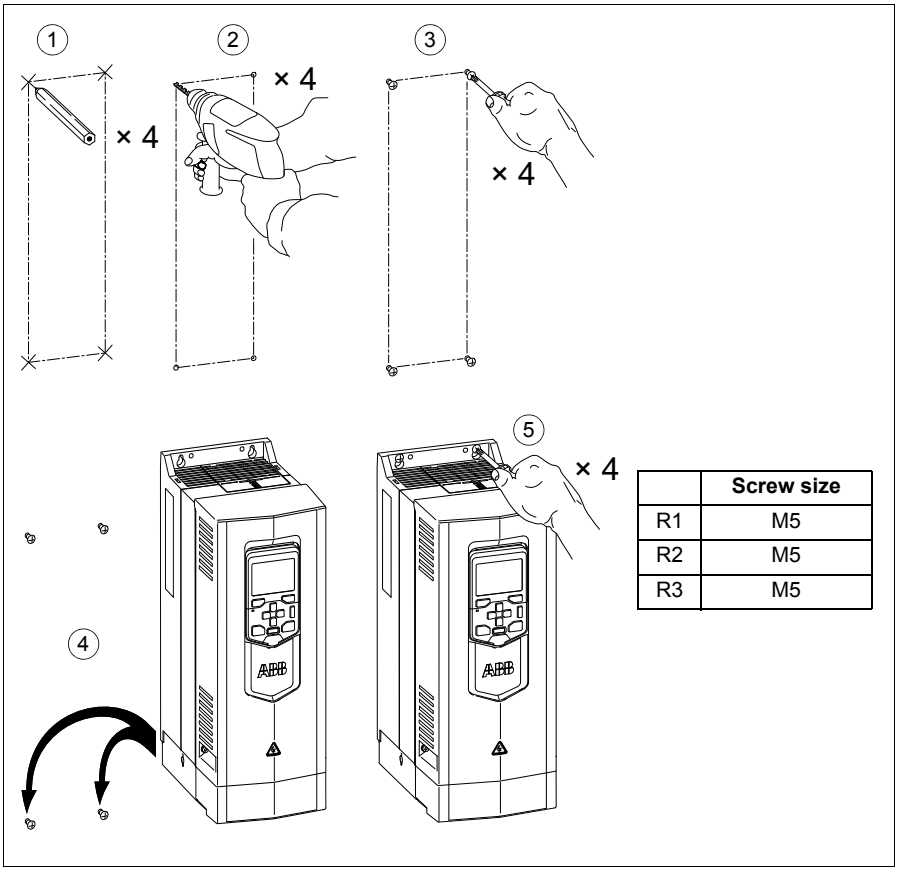


Installing the drive

These instructions are for drives without vibration dampers. For drives with vibration dampers (option +C131), see the additional instructions (included with the dampers and on the manuals CD).

Frames R1 to R4

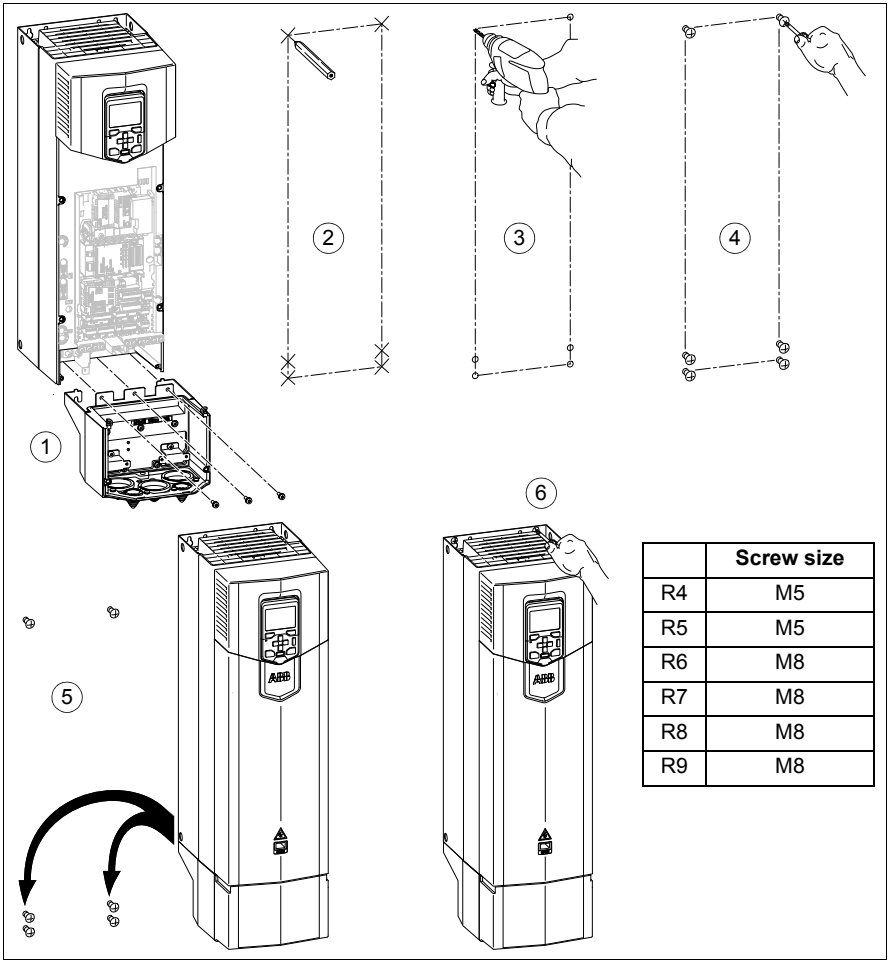
1. See the dimensions in chapter *Dimension drawings*. Mark the locations for the four mounting holes.
2. Drill the mounting holes.
3. Start the screws or bolts into the mounting holes.
4. Position the drive onto the screws on the wall.
5. Tighten the screws in the wall securely.



	Screw size
R1	M5
R2	M5
R3	M5

Frames R5 to R9 without vibration dampers

1. For IP21 units: Attach the cable entry box to the drive frame. For instructions, see the assembly drawing in the cable entry box. A view of frame R5 is shown below.
2. See the dimensions in chapter *Dimension drawings*. Mark the locations for the four or six mounting holes.
3. Drill the mounting holes.
4. Start the screws or bolts into the mounting holes.
5. Position the drive onto the screws on the wall.
6. Tighten the accessible screws in the wall securely.



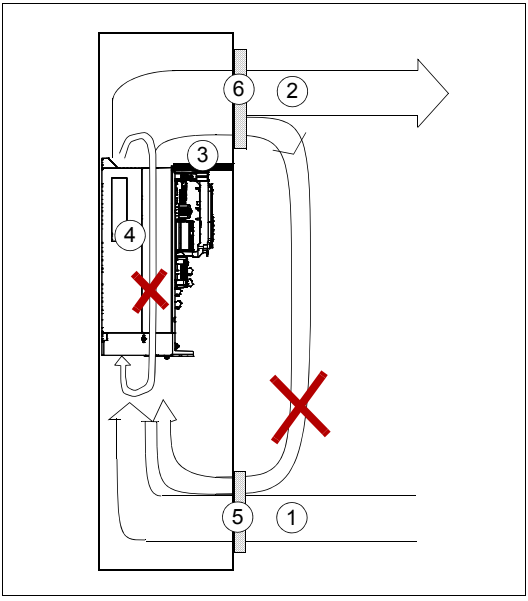
	Screw size
R4	M5
R5	M5
R6	M8
R7	M8
R8	M8
R9	M8

Cabinet installation

Cooling

Make sure that there is sufficient cooling:

- Make sure that the temperature of the cooling air that goes into the drive does not exceed +40 °C (+104 °F).
- Prevent cooling air recirculation inside the cabinet. You can use air baffle plates or an extra fan at the inlet or outlet of the cabinet. if you use a fan, we recommend an inlet fan with a filter. Such a fan causes an overpressure inside the cabinet which helps to keep the dust out.
- Prevent cooling air recirculation outside the cabinet. Let the outlet air away from the inlet: to the other side of the cabinet or upwards.
- Make sure that there is sufficient cooling in the room in which the cabinet is placed.



1	Main air flow in
2	Main air flow out
3	Air baffle plate
4	Drive
5	Air inlet filter
6	Air outlet filter

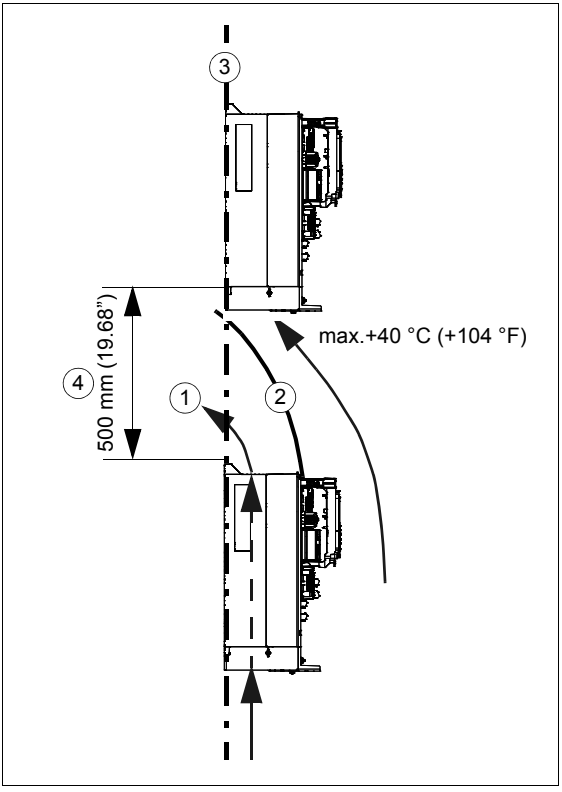
Note: You can remove the front cover of the drive module for better cooling.

Grounding inside the cabinet

Leave the contact surfaces of the attaching points of the drive unpainted (bare metal-to-metal contact). The drive frame will be grounded to the PE busbar of the cabinet via the attaching surfaces, screws and the cabinet frame. Alternatively, use a separate grounding conductor between the PE terminal of the drive and the PE busbar of the cabinet.

Installing drives above one another

Make sure that the outlet cooling air flows away from the drive above.



1	Air flow through the drive
2	Air baffle
3	Mounting plate that allows air through flow
4	Minimum spacing between the drives

5

Planning the electrical installation

What this chapter contains

This chapter contains instructions for planning the electrical installation of the drive. Some instructions are mandatory to follow in every installation, others provide useful information that only concerns certain applications.

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Selecting the supply disconnecting device

Install a hand-operated input disconnecting device between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

European Union

To meet the European Union Directives, according to standard EN 60204-1, *Safety of Machinery*, the disconnecting device must be one of the following types:

- switch-disconnector of utilization category AC-23B (EN 60947-3)
- disconnector that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
- circuit breaker suitable for isolation in accordance with EN 60947-2.

Other regions

The disconnecting device must conform to the applicable safety regulations.

Selecting and dimensioning the main contactor

If a main contactor is used, its utilization category (number of operations under load) must be AC-1 according to IEC 60947-4, *Low-voltage switchgear and controlgear*. Dimension the main contactor according to the nominal voltage and current of the drive.

Checking the compatibility of the motor and drive

Use an asynchronous AC induction motor, permanent magnet synchronous motor or AC induction servomotor with the drive. Several induction motors can be connected to the drive at a time.

Select the motor size and drive type from to the rating tables in chapter *Technical data* on basis of the AC line voltage and motor load. Use the DriveSize PC tool if you need to tune the selection more in detail.

Ensure that the motor withstands the maximum peak voltage in the motor terminals. See the *Requirements table* on page *53*. For basics of protecting the motor insulation and bearings in drive systems, refer to section *Protecting the motor insulation and bearings* below.

Note:

- Consult the motor manufacturer before using a motor whose nominal voltage differs from the AC line voltage connected to the drive input.
- The voltage peaks at the motor terminals are relative to the supply voltage of the drive, not the drive output voltage.
- If the motor and drive are not of the same size, consider the following operation limits of the drive control program:
  - motor nominal voltage range 1/6 ... 2 · U_N
  - motor nominal current range 1/6 ... 2 · I_N of the drive in DTC control and 0 ... 2 · I_N in scalar control. The control mode is selected by a drive parameter.

Protecting the motor insulation and bearings

The drive employs modern IGBT inverter technology. Regardless of frequency, the drive output comprises pulses of approximately the drive DC bus voltage with a very short rise time. The pulse voltage can almost double at the motor terminals, depending on the attenuation and reflection properties of the motor cable and the terminals. This can cause additional stress on the motor and motor cable insulation.

Modern variable speed drives with their fast rising voltage pulses and high switching frequencies can generate current pulses that flow through the motor bearings. This can gradually erode the bearing races and rolling elements.

Optional du/dt filters protect motor insulation system and reduce bearing currents. Optional common mode filters mainly reduce bearing currents. Insulated N-end (non-drive end) bearings protect the motor bearings.

Requirements table

The following table shows how to select the motor insulation system and when an optional drive du/dt and common mode filters and insulated N-end (non-drive end) motor bearings are required. Ignoring the requirements or improper installation may shorten motor life or damage the motor bearings and voids the warranty.

Motor type	Nominal AC supply voltage	Requirement for		
		Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings	
			P_N < 100 kW and frame size < IEC 315	100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400
			P_N < 134 hp and frame size < NEMA 500	134 hp ≤ P_N < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580
ABB motors				
Random-wound M2_,M3_ and M4_	U_N ≤ 500 V	Standard	-	+ N
	500 V < U_N ≤ 600 V	Standard	+ du/dt	+ du/dt + N
		or		
		Reinforced	-	+ N
	600 V < U_N ≤ 690 V (cable length ≤ 150 m)	Reinforced	+ du/dt	+ du/dt + N
	600 V < U_N ≤ 690 V (cable length > 150 m)	Reinforced	-	+ N
Form-wound HX_ and AM_	380 V < U_N ≤ 690 V	Standard	n.a.	+ N + CMF
Old* form-wound HX_ and modular	380 V < U_N ≤ 690 V	Check with the motor manufacturer.	+ du/dt with voltages over 500 V + N + CMF	
Random-wound HX_ and AM_ **	0 V < U_N ≤ 500 V	Enamelled wire with fiber glass taping	+ N + CMF	
	500 V < U_N ≤ 690 V		+ du/dt + N + CMF	
HDP	Consult the motor manufacturer.			

* manufactured before 1.1.1998

** For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.

Motor type	Nominal AC supply voltage	Requirement for		
		Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings	
			P_N < 100 kW and frame size < IEC 315	**100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400**
			P_N < 134 hp and frame size < NEMA 500	**134 hp ≤ P_N < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580**
Non-ABB motors				
Random-wound and form-wound	$U_N \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	-	+ N or CMF
	420 V < $U_N \leq$ 500 V	Standard: $\hat{U}_{LL}$ = 1300 V	+ du/dt	+ du/dt + (N or CMF)
		or		
		Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	-	+ N or CMF
	500 V < $U_N \leq$ 600 V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ du/dt	+ du/dt + (N or CMF)
		or		
		Reinforced: $\hat{U}_{LL}$ = 1800 V	-	+ N or CMF
	600 V < $U_N \leq$ 690 V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ du/dt	+ du/dt + N
		Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time ***	-	N + CMF

*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

The abbreviations used in the table are defined below.

Abbr.	Definition
U_N	Nominal AC line voltage
$\hat{U}_{LL}$	Peak line-to-line voltage at motor terminals which the motor insulation must withstand
P_N	Motor nominal power
du/dt	du/dt filter at the output of the drive. Available from ABB as an optional add-on kit.
CMF	Common mode filter. Depending on the drive type, CMF is available from ABB as an optional add-on kit.
N	N-end bearing: insulated motor non-drive end bearing
n.a.	Motors of this power range are not available as standard units. Consult the motor manufacturer.

Additional requirements for explosion-safe (EX) motors

If you will use an explosion-safe (EX) motor, follow the rules in the requirements table above. In addition, consult the motor manufacturer for any further requirements.

Additional requirements for ABB motors of types other than M2_, M3_, M4_, HX_ and AM_

Use the selection criteria given for non-ABB motors.

Additional requirements for the braking applications

When the motor brakes the machinery, the intermediate circuit DC voltage of the drive increases, the effect being similar to increasing the motor supply voltage by up to 20 percent. Consider this voltage increase when specifying the motor insulation requirements if the motor will be braking a large part of its operation time.

Example: Motor insulation requirement for a 400 V AC line voltage application must be selected as if the drive were supplied with 480 V.

Additional requirements for ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347 (2001). This table shows the requirements for ABB random-wound motor series (for example, M3AA, M3AP and M3BP).

Nominal mains voltage (AC line voltage)	**Requirement for**			
	Motor insulation system	**ABB du/dt and common mode filters, insulated N-end motor bearings**		
		P_N < 100 kW	**100 kW ≤ P_N < 200 kW**	**P_N ≥ 200 kW**
		P_N < 140 hp	**140 hp ≤ P_N < 268 hp**	**P_N ≥ 268 hp**
$U_N \leq 500$ V	Standard	-	+ N	+ N + CMF
500 V < $U_N \leq 600$ V	Standard	+ du/dt	+ du/dt + N	+ du/dt + N + CMF
	or			
	Reinforced	-	+ N	+ N + CMF
600 V < $U_N \leq 690$ V	Reinforced	+ du/dt	+ du/dt + N	+ du/dt + N + CMF

Additional requirements for non-ABB high-output and IP23 motors

The rated output power of high output motors is higher than what is stated for the particular frame size in EN 50347 (2001). The table below shows the requirements for random-wound and form-wound non-ABB motors.

Nominal AC line voltage	**Requirement for**		
	Motor insulation system	**ABB du/dt filter, insulated N-end bearing and ABB common mode filter**	
		P_N < 100 kW or frame size < IEC 315	**100 kW ≤ P_N < 350 kW or IEC 315 ≤ frame size < IEC 400**
		P_N < 134 hp or frame size < NEMA 500	**134 hp ≤ P_N < 469 hp or NEMA 500 ≤ frame size ≤ NEMA 580**
$U_N \leq 420$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ N or CMF	+ N + CMF
420 V < $U_N \leq 500$ V	Standard: $\hat{U}_{LL}$ = 1300 V	+ du/dt + (N or CMF)	+ du/dt + N + CMF
	or		
	Reinforced: $\hat{U}_{LL}$ = 1600 V, 0.2 microsecond rise time	+ N or CMF	+ N + CMF
500 V < $U_N \leq 600$ V	Reinforced: $\hat{U}_{LL}$ = 1600 V	+ du/dt + (N or CMF)	+ du/dt + N + CMF
	or		
	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ N or CMF	+ N + CMF
600 V < $U_N \leq 690$ V	Reinforced: $\hat{U}_{LL}$ = 1800 V	+ du/dt + N	+ du/dt + N + CMF
	Reinforced: $\hat{U}_{LL}$ = 2000 V, 0.3 microsecond rise time ***	N + CMF	N + CMF

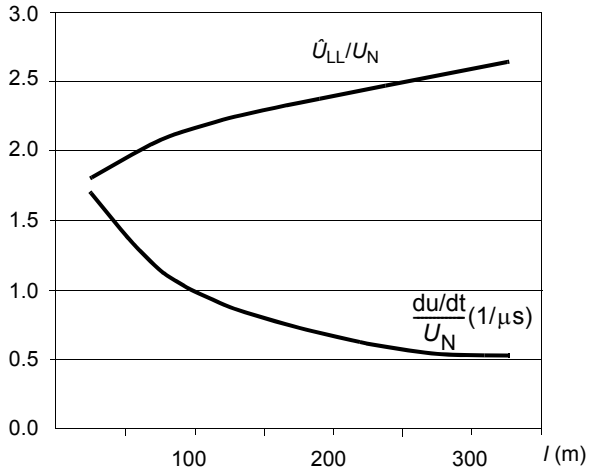
*** If the intermediate DC circuit voltage of the drive is increased from the nominal level by resistor braking, check with the motor manufacturer if additional output filters are needed in the applied drive operation range.

Additional data for calculating the rise time and the peak line-to-line voltage

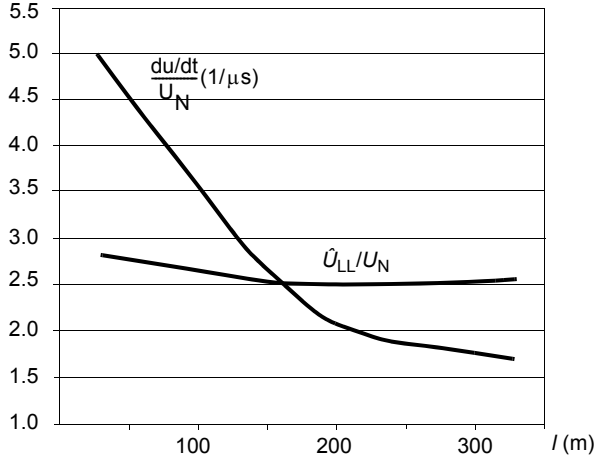
If you need to calculate the actual peak voltage and voltage rise time considering the actual cable length, proceed as follows:

- Peak line-to line voltage: Read the relative $\hat{U}_{LL}/U_N$ value from the appropriate diagram below and multiply it by the nominal supply voltage (U_N).
- Voltage rise time: Read the relative values $\hat{U}_{LL}/U_N$ and (du/dt)/U_N from the appropriate diagram below. Multiply the values by the nominal supply voltage (U_N) and substitute into equation $t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.

A



B



A	Drive with du/dt filter
B	Drive without du/dt filter
l	Motor cable length
$\hat{U}_{LL}/U_N$	Relative peak line-to-line voltage
$(du/dt)/U_N$	Relative du/dt value
Note: ÛLL and du/dt values are approximately 20% higher with resistor braking.	

Additional note for sine filters

Sine filters protect the motor insulation system. Therefore, du/dt filter can be replaced with a sine filter. The peak phase-to-phase voltage with the sine filter is approximately $1.5 \cdot U_N$.

Selecting the power cables

General rules

Select the input power and motor cables **according to local regulations**:

- Select a cable capable of carrying the drive nominal current. See section *Ratings* (page *134*) for the rated currents.
- Select a cable rated for at least 70 °C maximum permissible temperature of conductor in continuous use. For US, see *Additional US requirements,* page *66.*
- The inductance and impedance of the PE conductor/cable (grounding wire) must be rated according to permissible touch voltage appearing under fault conditions (so that the fault point voltage will not rise excessively when a ground fault occurs).
- 600 V AC cable is accepted for up to 500 V AC. 750 V AC cable is accepted for up to 600 V AC. For 690 V AC rated equipment, the rated voltage between the conductors of the cable should be at least 1 kV.

Use symmetrical shielded motor cable (see page *64*) for drive frame size R5 and larger, or motors larger than 30 kW (40 hp). A four-conductor system can be used up to frame size R4 with up to 30 kW (40 hp) motors, but shielded symmetrical motor cable is always recommended. Ground motor cable shields 360° at both ends. Keep the motor cable and its PE pigtail (twisted shield) as short as possible to reduce high-frequency electromagnetic emissions.

Note: When continuous metal conduit is employed, shielded cable is not required. The conduit must have bonding at both ends.

A four-conductor system is allowed for input cabling, but shielded symmetrical cable is recommended.

Compared to a four-conductor system, the use of symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as the stress on motor insulation, bearing currents and wear.

The protective conductor must always have an adequate conductivity. The table below shows the minimum cross-sectional area related to the phase conductor size according to IEC 61439-1 when the phase conductor and the protective conductor are made of the same metal.

Cross-sectional area of the phase conductors S (mm^2)	Minimum cross-sectional area of the corresponding protective conductor S_p (mm^2)
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

Typical power cable sizes

The table below gives copper and aluminum cable types with concentric copper shield for the drives with nominal current.

Drive type ACS880-01-	Frame size	IEC [1]		US [2]	
		Cu cable type	Al cable type	Cu cable type	Al cable type
		mm^2	mm^2	AWG/kcmil	AWG/kcmil
U_N = 208…240 V					
04A6-2	R1	3×1.5	-	14	-
06A6-2	R1	3×1.5	-	14	-
07A5-2	R1	3×1.5	-	14	-
10A6-2	R1	3×1.5	-	14	-
16A8-2	R2	3×6	-	10	-
24A3-2	R2	3×6	-	10	-
031A-2	R3	3×10	-	8	-
U_N = 380…415 V					
02A4-3	R1	3×1.5	-	14	-
03A3-3	R1	3×1.5	-	14	-
04A0-3	R1	3×1.5	-	14	-
05A6-3	R1	3×1.5	-	14	-
07A2-3	R1	3×1.5	-	14	-
09A4-3	R1	3×1.5	-	14	-
12A6-3	R1	3×1.5	-	14	-
017A-3	R2	3×6	-	10	-
025A-3	R2	3×6	-	10	-
032A-3	R3	3×10	-	8	-
038A-3	R3	3×10	-	8	-
045A-3	R4	3×16	3×35	6	-
061A-3	R4	3×25	3×35	4	-
072A-3	R5	3×35	3×50	3	-
087A-3	R5	3×35	3×70	3	-
105A-3	R6	3×50	3×70	1	-
145A-3	R6	3×95	3×120	2/0	-
169A-3	R7	3×120	3×150	3/0	-

Drive type ACS880-01-	Frame size	IEC [1]		US [2]	
		Cu cable type	Al cable type	Cu cable type	Al cable type
		mm^2	mm^2	AWG/kcmil	AWG/kcmil
206A-3	R7	3×150	3×240	250 MCM	-
246A-3	R8	2 × (3×70) [3]	2 × (3×95)	2 × 300 MCM	-
293A-3	R8	2 × (3×95) [3]	2 × (3×120)	2 × 3/0	-
363A-3	R9	2 × (3×120)	2 × (3×185)	2 × 4/0	-
430A-3	R9	2 × (3×150)	2 × (3×240)	2 × 250 MCM	-
U_N = 440…500 V					
02A1-5	R1	3×1.5	-	14	
03A0-5	R1	3×1.5	-	14	-
03A4-5	R1	3×1.5	-	14	-
04A8-5	R1	3×1.5	-	14	-
05A2-5	R1	3×1.5	-	14	-
07A6-5	R1	3×1.5	-	14	-
11A0-5	R1	3×1.5	-	14	-
014A-5	R2	3×6	-	10	-
021A-5	R2	3×6	-	10	-
027A-5	R3	3×10	-	8	-
034A-5	R3	3×10	-	8	-
040A-5	R4	3×16	3×25	6	-
052A-5	R4	3×25	3×25	4	-
065A-5	R5	3×35	3×35	3	-
077A-5	R5	3×35	3×50	3	-
096A-5	R6	3×50	3×70	1	-
124A-5	R6	3×95	3×95	2/0	-
156A-5	R7	3×120	3×150	3/0	-
180A-5	R7	3×150	3×185	250 MCM	-
240A-5	R8	2 × (3×70) [3]	2 × (3×95)	300 MCM	-
260A-5	R8	2 × (3×70) [3]	2 × (3×95)	2 × 3/0	-
302A-5	R9	2 × (3×95)	2 × (3×120)	2 × 3/0	-
361A-5	R9	2 × (3×120)	2 × (3×185)	2 × 250 MCM	-
414A-5	R9	2 × (3×150)	2 × (3×240)	2 × 250 MCM	-
U_N = 525…690 V					
07A3-7	R5	3×1.5	-	14	12
09A8-7	R5	3×1.5	-	14	12
14A2-7	R5	3×2.5	-	14	12
018A-7	R5	3×4	-	12	10
022A-7	R5	3×6	-	10	8
026A-7	R5	3×10	3×25	8	6
035A-7	R5	3×10	3×25	8	6

Drive type ACS880-01-	Frame size	IEC [1]		US [2]	
		Cu cable type	Al cable type	Cu cable type	Al cable type
		mm²	mm²	AWG/kcmil	AWG/kcmil
042A-7	R5	3×16	3×25	6	4
049A-7	R5	3×16	3×25	6	4
061A-7	R6	3×25	3×35	4	3
084A-7	R6	3×35	3×50	3	2
098A-7	R7	3×50	3×70	2	1/0
119A-7	R7	3×70	3×95	1/0	3/0
142A-7	R8	3×95 [3]	3×120	2/0	4/0
174A-7	R8	3×120 [3]	2 × (3×70)	4/0	300
210A-7	R9	3×185	2 × (3×95)	300 MCM	2 × 3/0
271A-7	R9	3×240	2 × (3×120)	400 MCM	2 × 4/0

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1) The cable sizing is based on max. 9 cables laid on a cable ladder side by side, three ladder type trays one on top of the other, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. See also page *153* for the accepted cable sizes of the drive.

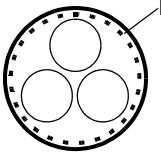
2) The cable sizing is based on NEC Table 310-16 for copper wires, 75 °C (167 °F) wire insulation at 40 °C (104 °F) ambient temperature. Not more than three current-carrying conductors in raceway or cable or earth (directly buried). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. See also page *154* for the accepted cable sizes of the drive.

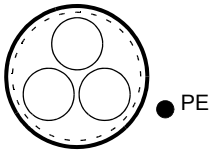
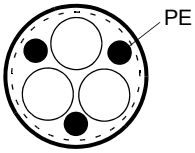
3) The biggest cable size accepted by the connection terminals of frame R8 is 2 × (3×150). Biggest possible cable size is 3x240 or 400 MCM if the terminal type is changed and the cable entry box is not used.

Alternative power cable types

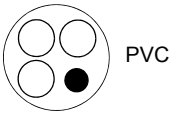
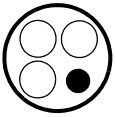
The recommended and not allowed power cable types to be used with the drive are presented below.

Recommended power cable types

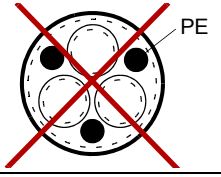
	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. The shield must meet the requirements of IEC 61439-1, see page *61*. Check with local / state / country electrical codes for allowance.

	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as shield. A separate PE conductor is required if the shield does not meet the requirements of IEC 61439-1, see page *61*.
	Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61439-1.

Power cable types for restricted use

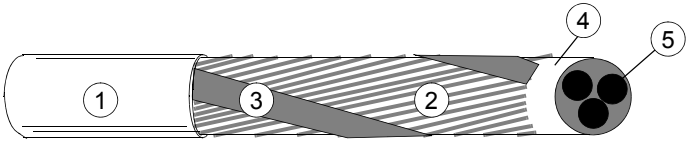
	A four-conductor system (three phase conductors and a protective conductor on a cable tray) is **not allowed for motor cabling** (it is allowed for input cabling).
	A four-conductor system (three phase conductors and a PE conductor in a PVC conduit) is **allowed for input and motor cabling with phase conductor cross-section less than 10 mm^2 (8 AWG) or motors ≤ 30 kW (40 hp)**. Not allowed in USA.
	Corrugated or EMT cable with three phase conductors and a protective conductor is allowed for motor cabling with phase conductor cross section less than 10 mm^2 (8 AWG) or motors ≤ 30 kW (40 hp).

Not allowed power cable types

	Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input and motor cabling.

Motor cable shield

If the motor cable shield is used as the sole protective earth conductor of the motor, ensure that the conductivity of the shield is sufficient. See subsection *General rules* above, or IEC 61439-1. To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



1	Insulation jacket
2	Copper wire screen
3	Helix of copper tape or copper wire
4	Inner insulation
5	Cable core

Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. 1000 V AC cable is required above 500 V AC (below 600 V AC). For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

Couple separate parts of a conduit together: bridge the joints with a ground conductor bonded to the conduit on each side of the joint. Also bond the conduits to the drive enclosure and motor frame. Use separate conduits for input power, motor, brake resistor, and control wiring. When conduit is employed, type MC continuous corrugated aluminum armor cable or shielded cable is not required. A dedicated ground cable is always required.

Note: Do not run motor wiring from more than one drive in the same conduit.

Armored cable / shielded power cable

Six conductor (3 phases and 3 ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX).

Shielded power cables are available from Belden, LAPPKABEL (ÖLFLEX) and Pirelli.

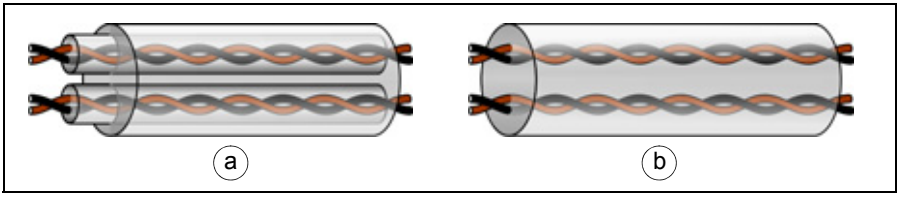
Selecting the control cables

Shielding

All control cables must be shielded.

Use a double-shielded twisted pair cable for analog signals. This type of cable is recommended for the pulse encoder signals also. Employ one individually shielded pair for each signal. Do not use common return for different analog signals.

A double-shielded cable (figure a below) is the best alternative for low-voltage digital signals but single-shielded (b) twisted pair cable is also acceptable.



Signals in separate cables

Run analog and digital signals in separate, shielded cables.

Never mix 24 V DC and 115/230 V AC signals in the same cable.

Signals allowed to be run in the same cable

Relay-controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. The relay-controlled signals should be run as twisted pairs.

Relay cable type

The cable type with braided metallic screen (for example ÖLFLEX by LAPPKABEL, Germany) has been tested and approved by ABB.

Control panel cable length and type

In remote use, the cable connecting the control panel to the drive must not exceed three meters (10 ft). Cable type: shielded CAT 5e or better Ethernet patch cable with RJ-45 ends.

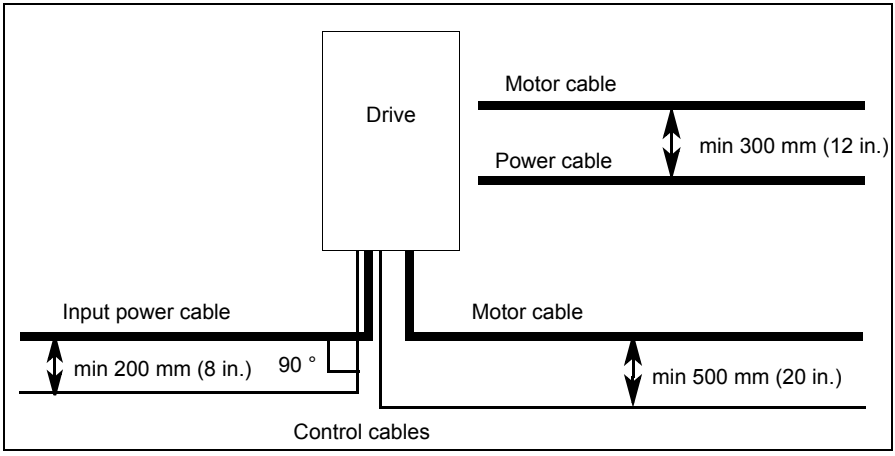
Routing the cables

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel installed next to each other. The motor cable, input power cable and control cables should be installed on separate trays. Avoid long parallel runs of motor cables with other cables in order to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.

Where control cables must cross power cables, ensure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

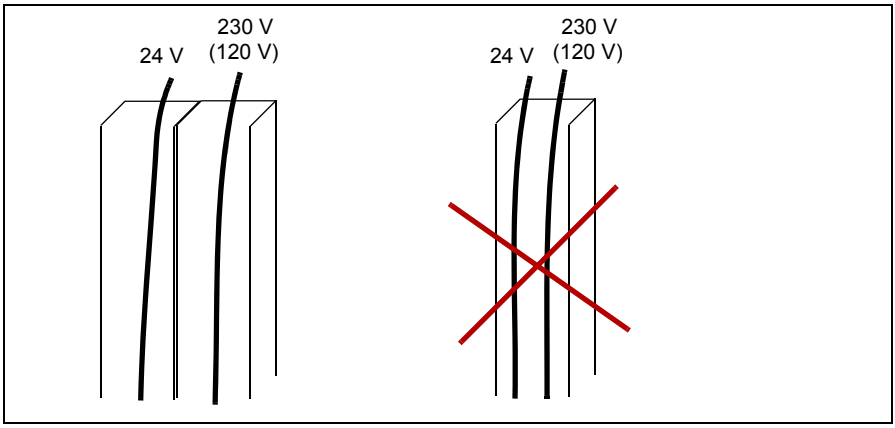
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

A diagram of the cable routing is shown below.



Separate control cable ducts

Lead 24 V and 230 V (120 V) control cables in separate ducts unless the 24 V cable is insulated for 230 V (120 V) or insulated with an insulation sleeving for 230 V (120 V).



Continuous motor cable shield or enclosure for equipment on the motor cable

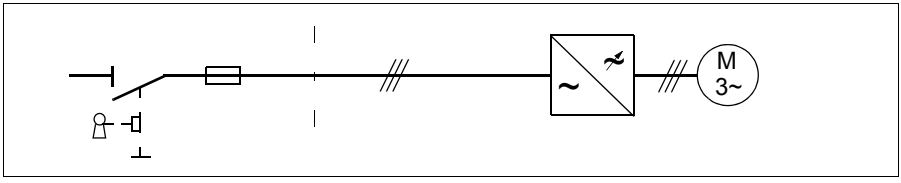
To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed on the motor cable between the drive and the motor:

- European Union: Install the equipment in a metal enclosure with 360 degree grounding for the shields of both the incoming and outgoing cable, or connect the shields of the cables otherwise together.
- US: Install the equipment in a metal enclosure in a way that the conduit or motor cable shielding runs consistently without breaks from the drive to the motor.

Implementing thermal overload and short-circuit protection

Protecting the drive and input power cable in short-circuits

Protect the drive and input cable with fuses as follows:



Size the fuses at the distribution board according to instructions given in chapter *Technical data*. The fuses will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Note: Circuit breakers must not be used without fuses. For more information, contact ABB.

Protecting the motor and motor cable in short-circuits

The drive protects the motor cable and motor in a short-circuit situation when the motor cable is sized according to the nominal current of the drive. No additional protection devices are needed.

Protecting the drive and the input power and motor cables against thermal overload

The drive protects itself and the input and motor cables against thermal overload when the cables are sized according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, use a separate circuit breaker or fuses for protecting each motor cable and motor against overload. The drive overload protection is tuned for the total motor load. It may not trip due to an overload in one motor circuit only

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Protecting the motor against thermal overload

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value, the function either monitors a calculated temperature value (based on a motor thermal model) or an actual temperature indication given by motor temperature sensors. The user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:

- motor sizes IEC180…225: thermal switch, eg, Klixon
- motor sizes IEC200…250 and larger: PTC or Pt100.

See the firmware manual for more information on the motor thermal protection, and the connection and use of the temperature sensors.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and motor cable. This is not a personnel safety or a fire protection feature. The ground fault protective function can be disabled with a parameter, refer to the firmware manual.

Residual current device compatibility

The drive is suitable to be used with residual current devices of Type B.

Note: The EMC filter of the drive includes capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and may cause fault current circuit breakers to function.

Implementing the Emergency stop function

For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed. You can use the Safe torque off function of the drive to implement the Emergency stop function. See chapter *Safe Torque off function* on page *189*.

Note: Pressing the stop key ⛛ on the control panel of the drive does not generate an emergency stop of the motor or separate the drive from dangerous potential.

Implementing the Safe torque off function

See chapter *Safe Torque off function* on page *189*.

Implementing the Safety functions (option +Q973)

The drive can be equipped with a safety functions module which includes, for example, the following functions: Safe torque off (STO), Safe acceleration range (SAR), Safe brake control (SBC), Safely-limited speed (SLS), Safe speed 1 (SS1), Safe stop emergency (SSE) and Safe maximum speed (SMS). The option uses the internal Safe torque off function of the drive.

For the wiring of the safety functions module, see page *190*. For the mechanical installation, see page *109*. For safety data and more information on the option, see *FSO-11 user's manual* (3AUA0000097054 [English]).

Implementing the ATEX-certified Safe motor disconnection function (option +Q971)

With option +Q971, the drive supplies ATEX-certified safe motor disconnection without contactor that uses the drive Safe torque off function. For more information, see *ACS880 ATEX-certified Safe disconnection function application guide* (3AUA0000132231 [English]).

Implementing the Power-loss ride-through function

Implement the power-loss ride-through function as follows:

- Check that the power-loss ride-through function of the drive is enabled with parameter **30.31 Undervoltage control** in the ACS880 primary control program.
- If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.

WARNING! Make sure that the flying restart of the motor will not cause any danger. If you are in doubt, do not implement the Power-loss ride-through function.

Using power factor compensation capacitors with the drive

Power factor compensation is not needed with AC drives. However, if a drive is to be connected in a system with compensation capacitors installed, note the following restrictions.

WARNING! Do not connect power factor compensation capacitors or harmonic filters to the motor cables (between the drive and the motor). They are not meant to be used with AC drives and can cause permanent damage to the drive or themselves.

If there are power factor compensation capacitors in parallel with the three phase input of the drive:

1. Do not connect a high-power capacitor to the power line while the drive is connected. The connection will cause voltage transients that may trip or even damage the drive.
2. If capacitor load is increased/decreased step by step when the AC drive is connected to the power line, ensure that the connection steps are low enough not to cause voltage transients that would trip the drive.
3. Check that the power factor compensation unit is suitable for use in systems with AC drives, ie, harmonic generating loads. In such systems, the compensation unit should typically be equipped with a blocking reactor or harmonic filter.

Using a contactor between the drive and the motor

Implementing the control of the output contactor depends on how you select the drive to operate. See also section *Implementing a bypass connection* on page 73.

When you have selected to use DTC motor control mode and motor ramp stop, open the contactor as follows:

1. Give a stop command to the drive.
2. Wait until the drive decelerates the motor to zero speed.
3. Open the contactor.

When you have selected to use DTC motor control mode and motor coast stop, or scalar control mode, open the contactor as follows:

1. Give a stop command to the drive.
2. Open the contactor.

WARNING! When the DTC motor control mode is in use, never open the output contactor while the drive controls the motor. The DTC motor control operates extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor, the DTC control will try to maintain the load current by immediately increasing the drive output voltage to the maximum. This will damage, or even burn the contactor completely.

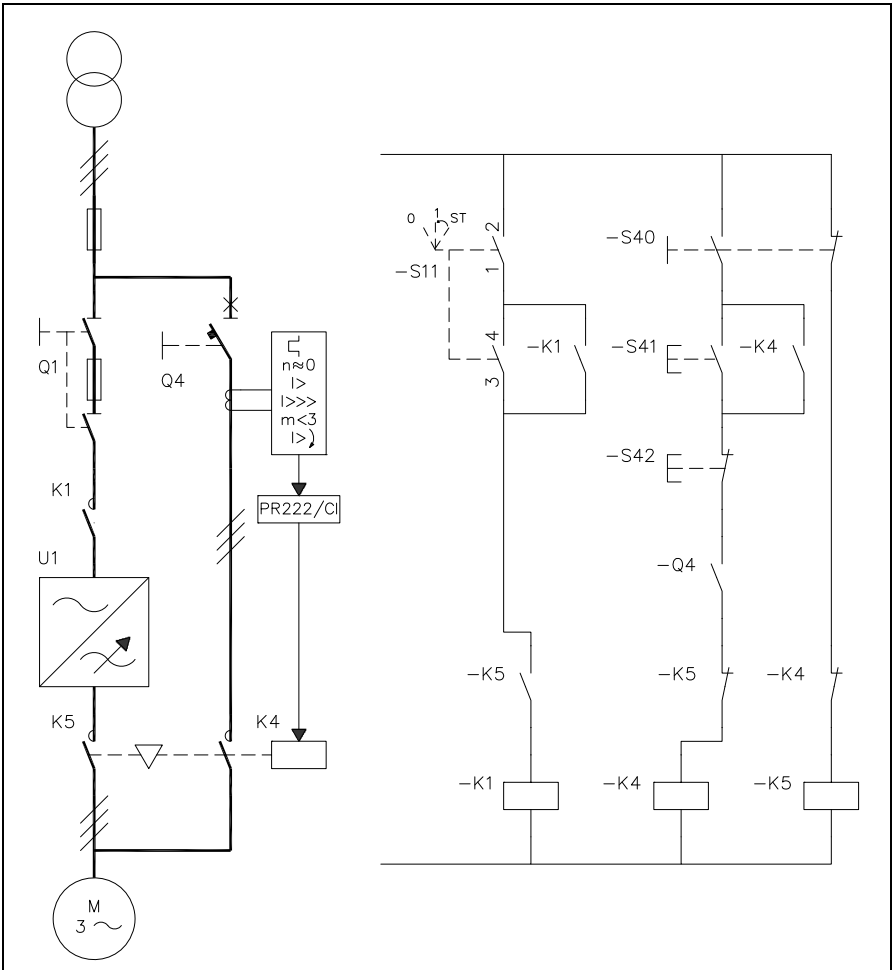
Implementing a bypass connection

If bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Ensure with interlocking that the contactors cannot be closed simultaneously.

WARNING! Never connect the drive output to the electrical power network. The connection may damage the drive.

Example bypass connection

An example bypass connection is shown below.



Q1	Drive main switch	S11	Drive main contactor on/off control
Q4	Bypass circuit breaker	S40	Motor power supply selection (drive or direct-on-line)
K1	Drive main contactor	S41	Start when motor is connected direct-on-line
K4	Bypass contactor	S42	Stop when motor is connected direct-on-line
K5	Drive output contactor		

Switching the motor power supply from drive to direct-on-line

1. Stop the drive and the motor with the drive control panel (drive in local control mode) or with the external stop signal (drive in remote control mode).
2. Open the main contactor of the drive with S11.
3. Switch the motor power supply from the drive to direct-on-line with S40.
4. Wait for 10 seconds to allow the motor magnetization to die away.
5. Start the motor with S41.

Switching the motor power supply from direct-on-line to drive

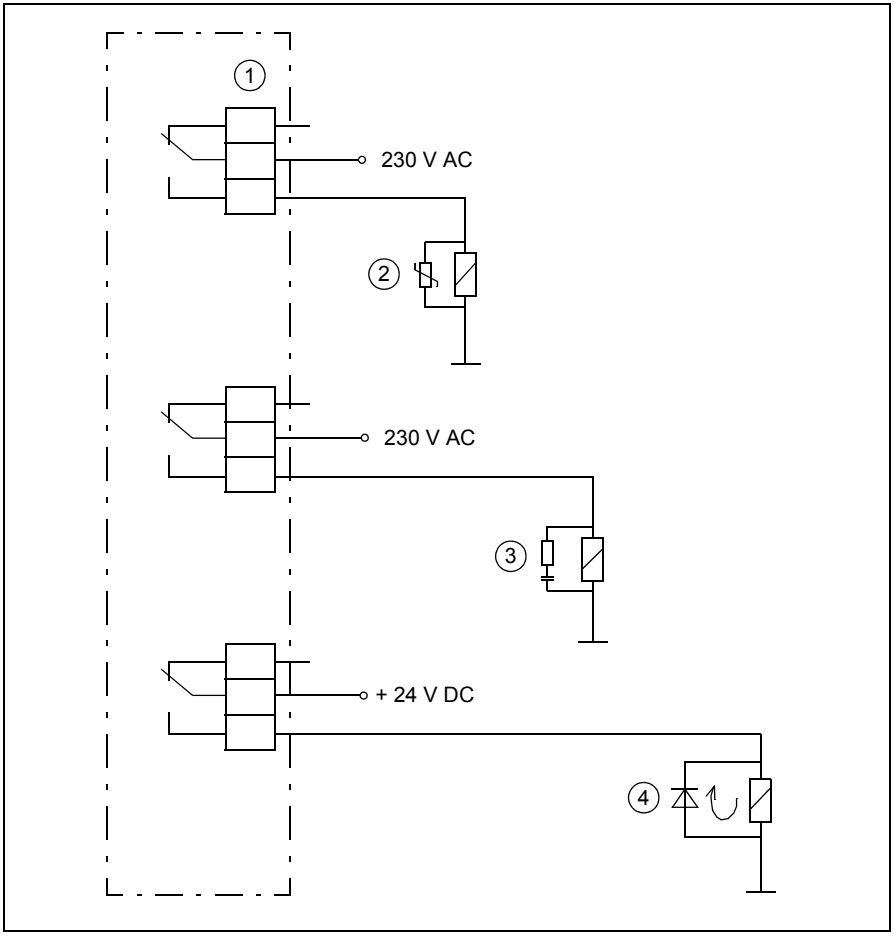
1. Stop the motor with S42.
2. Switch the motor power supply from direct-on-line to the drive with S40.
3. Close the main contactor of the drive with switch S11 (-> turn to position ST for two seconds and leave at position 1).
4. Start the drive and the motor with the drive control panel (drive in local control mode) or with the external start signal (drive in remote control mode).

Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

The relay contacts on the drive control unit are protected with varistors (250 V) against overvoltage peaks. In spite of this, it is highly recommended that inductive loads are equipped with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the relay outputs.



1) Relay outputs; 2) Varistor; 3) RC filter; 4) diode

Connecting a motor temperature sensor to the drive I/O

WARNING! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

To fulfill this requirement, the connection of a thermistor (and other similar components) to the digital inputs of the drive can be implemented in three alternate ways:

1. There is double or reinforced insulation between the thermistor and live parts of the motor.
2. Circuits connected to all digital and analog inputs of the drive are protected against contact and insulated with basic insulation (the same voltage level as the drive main circuit) from other low voltage circuits.
3. An external thermistor relay is used. The insulation of the relay must be rated for the same voltage level as the main circuit of the drive. For connection, see the firmware manual.

6

Electrical installation

What this chapter contains

This chapter gives instructions on wiring the drive.

Warnings

WARNING! Only qualified electricians are allowed to carry out the work described in this chapter. Follow the *Safety instructions* in the first chapter of this manual. Ignoring the safety instructions can cause physical injury or death.

Checking the insulation of the assembly

Drive

Do not make any voltage tolerance or insulation resistance tests on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

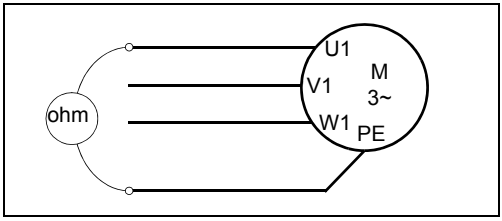
Input power cable

Check the insulation of the input cable according to local regulations before connecting it to the drive.

Motor and motor cable

Check the insulation of the motor and motor cable as follows:

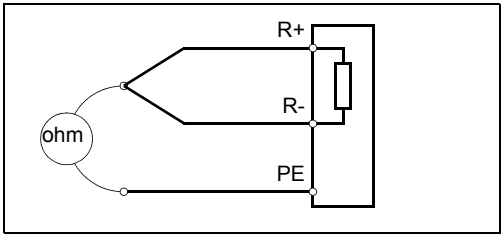
1. Check that the motor cable is disconnected from the drive output terminals T1/U, T2/V and T3/W.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions. **Note:** Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.



Brake resistor assembly

Check the insulation of the brake resistor assembly (if present) as follows:

1. Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.
2. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



Checking the compatibility with IT (ungrounded) systems

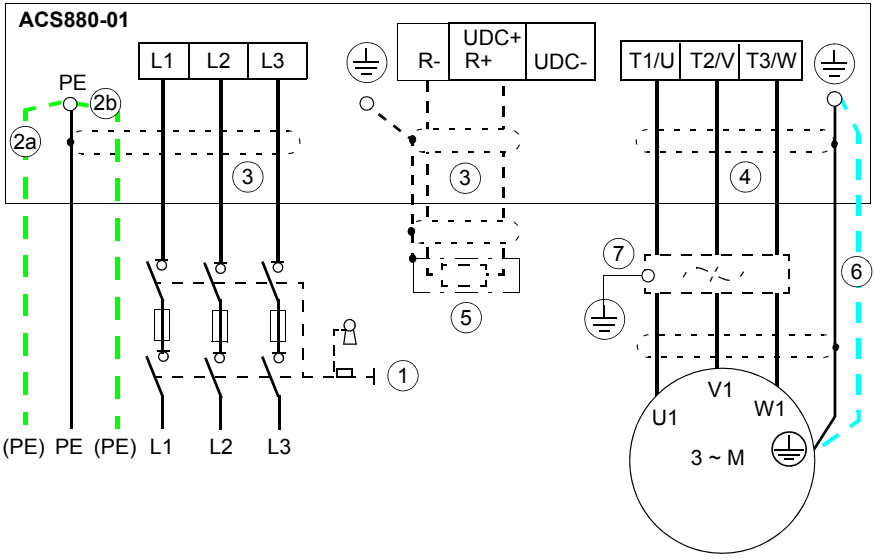
EMC filters +E200 and +E202 are not suitable for use in an IT (ungrounded) system. If the drive is equipped with filter +E200 or +E202, disconnect the filter before connecting the drive to the supply network. Undo the two screws which are marked with EMC AC and EMC DC on the skeleton. See *EMC filter disconnecting instructions for ACS880-01 drives with filters +E200 and +E202* (3AUA0000125152 [English]).

For frame R4, contact ABB.

WARNING! If a drive with EMC filter +E200 or +E202 is installed on an IT system (an ungrounded power system or a high resistance-grounded [over 30 ohm] power system), the system will be connected to earth potential through the EMC filter capacitors of the drive. This may cause danger, or damage the unit.

Connecting the power cables

Connection diagram



1	For alternatives, see section *Selecting the supply disconnecting device* on page *51*.
2	Use a separate grounding PE cable (2a) or a cable with a separate PE conductor (2b) if the conductivity of the shield does not meet the requirements for the PE conductor (see page *61*).
3	360-degree grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
4	360-degree grounding is required.
5	External brake resistor
6	Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 (see page *61*) and there is no symmetrically constructed grounding conductor in the cable (see page *66*).
7	du/dt filter or sine filter (optional, see page *213*).

Note:

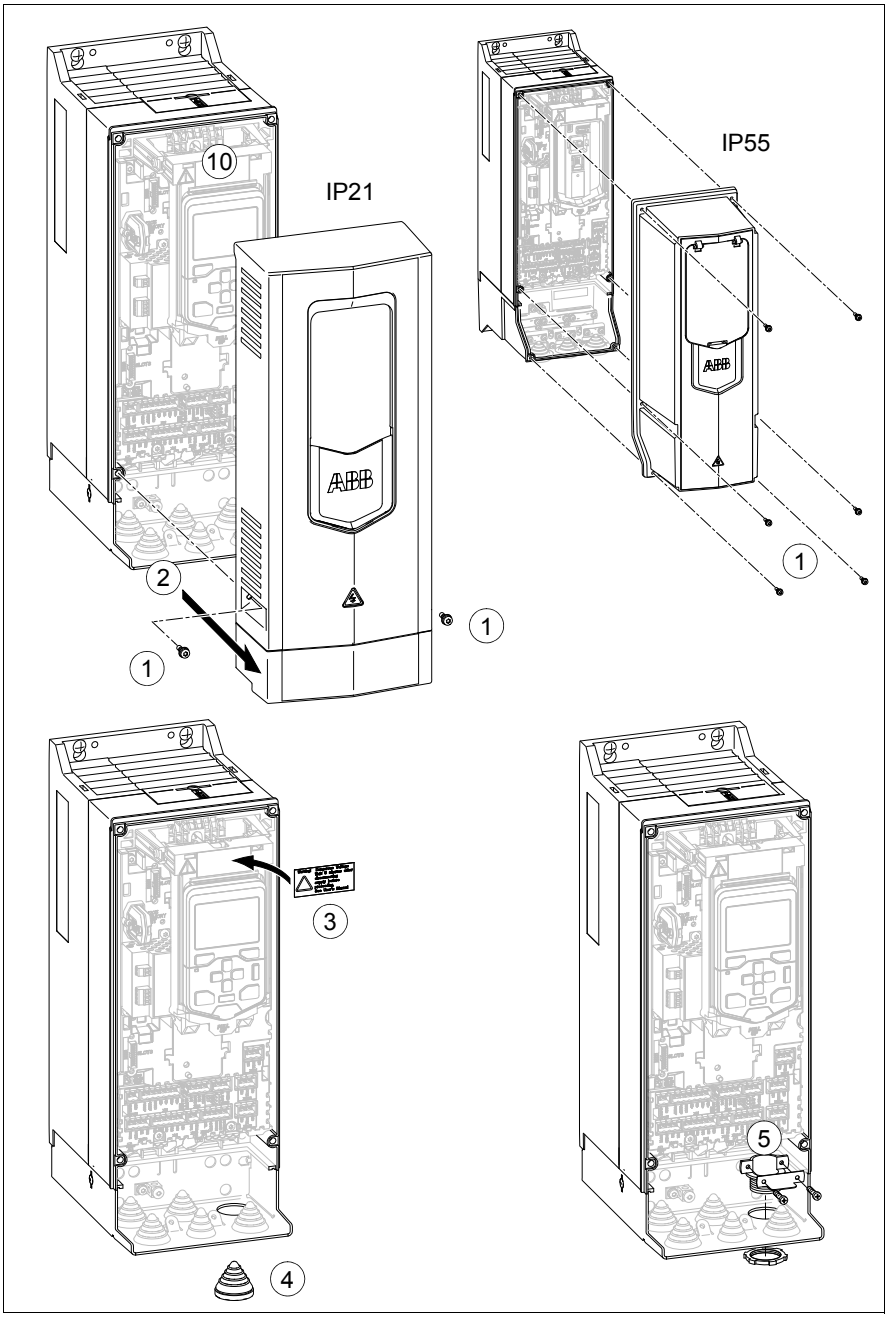
If there is a symmetrically constructed grounding conductor on the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

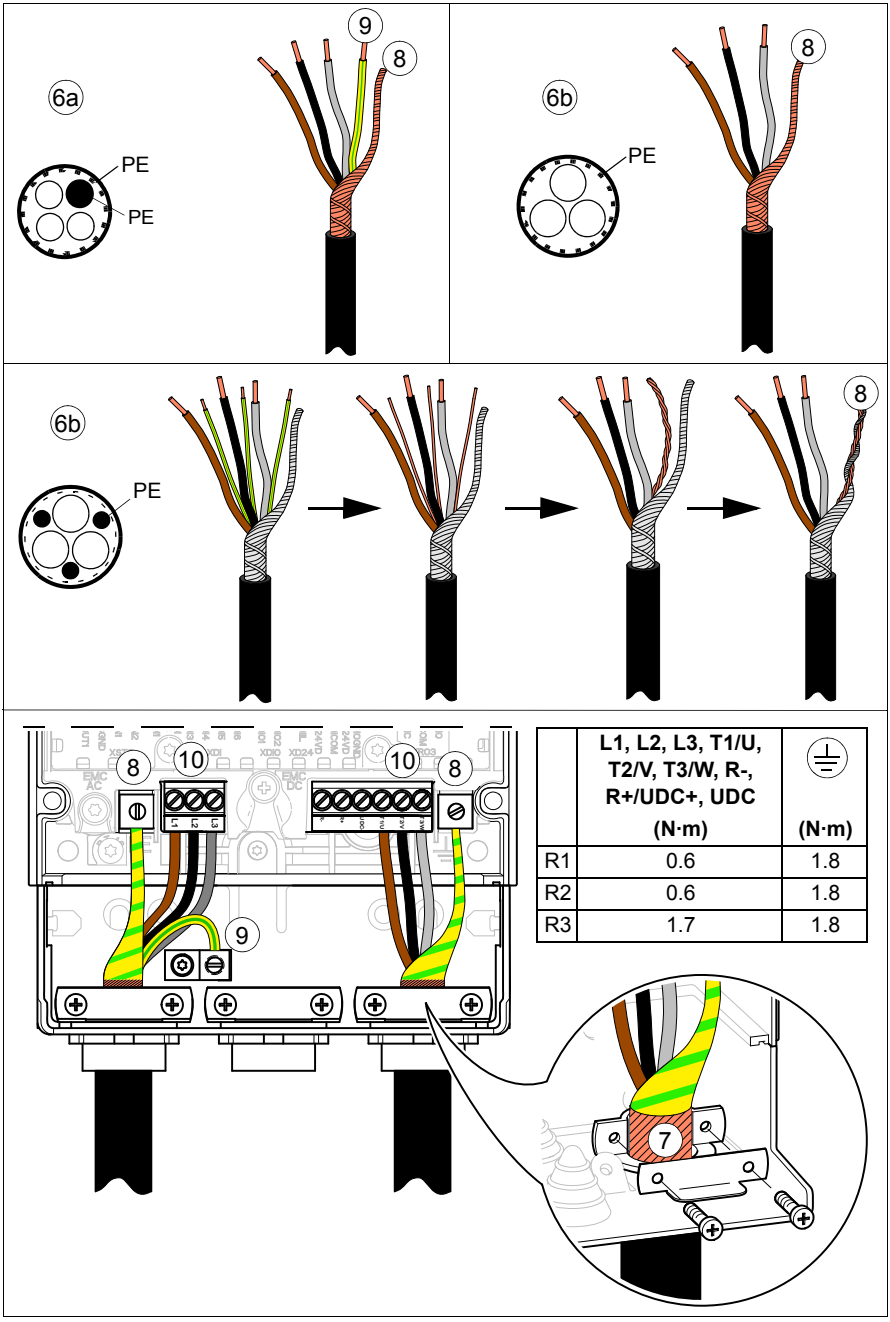
Do not use an asymmetrically constructed motor cable for motors above 30 kW (see page *61*). Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.

Connection procedure for frames R1 to R3

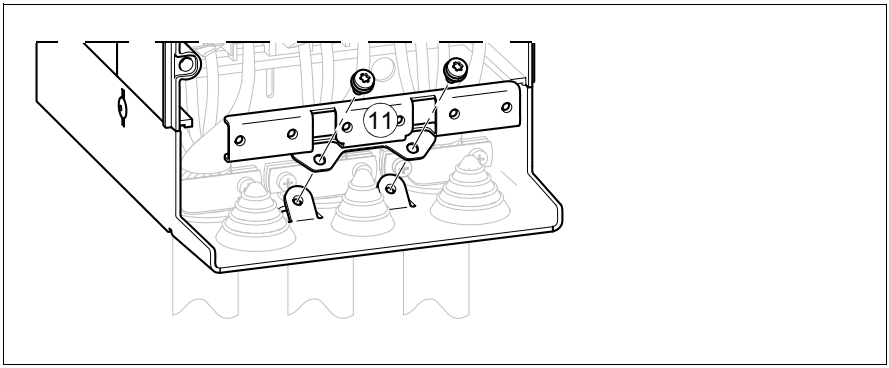
1. Undo the mounting screws at the sides of the front cover.
2. Remove the cover by sliding it forward.
3. Attach the residual voltage warning sticker in the local language to the control panel mounting platform.
4. Remove the rubber grommets from the lead-through plate for the cables to be connected.
5. IP21 units: Fasten the cable connectors (included in the delivery in a plastic bag) to the cable lead-through plate holes.
6. Prepare the ends of the input power (a) and motor cables (b) as illustrated in the figure. **Note**: Bare shield will be grounded 360 degrees.
7. IP21 units: Ground the shields 360 degrees in the connectors by tightening the connector onto the stripped part of the cable. IP55 units: Tighten the clamps onto the stripped part of the cables.
8. Connect the twisted shields of the input and motor cables to the grounding terminals.
9. Connect the additional PE conductor (if used, see page *15*) of the input cable to the grounding terminal.
10. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals and the phase conductors of the motor cable to the T1/U, T2/V and T3/W terminals. Tighten the screws to the torque given in the figure below.
11. Install the control cable grounding shelf in the cable entry box.
12. Secure the cables outside the unit mechanically.

Note: The drawings below show an IP21 unit. The IP55 unit looks slightly different. For US cable conduit installation, see the quick installation guide.


10
IP21
IP55
2
1
1
1
3
4
5



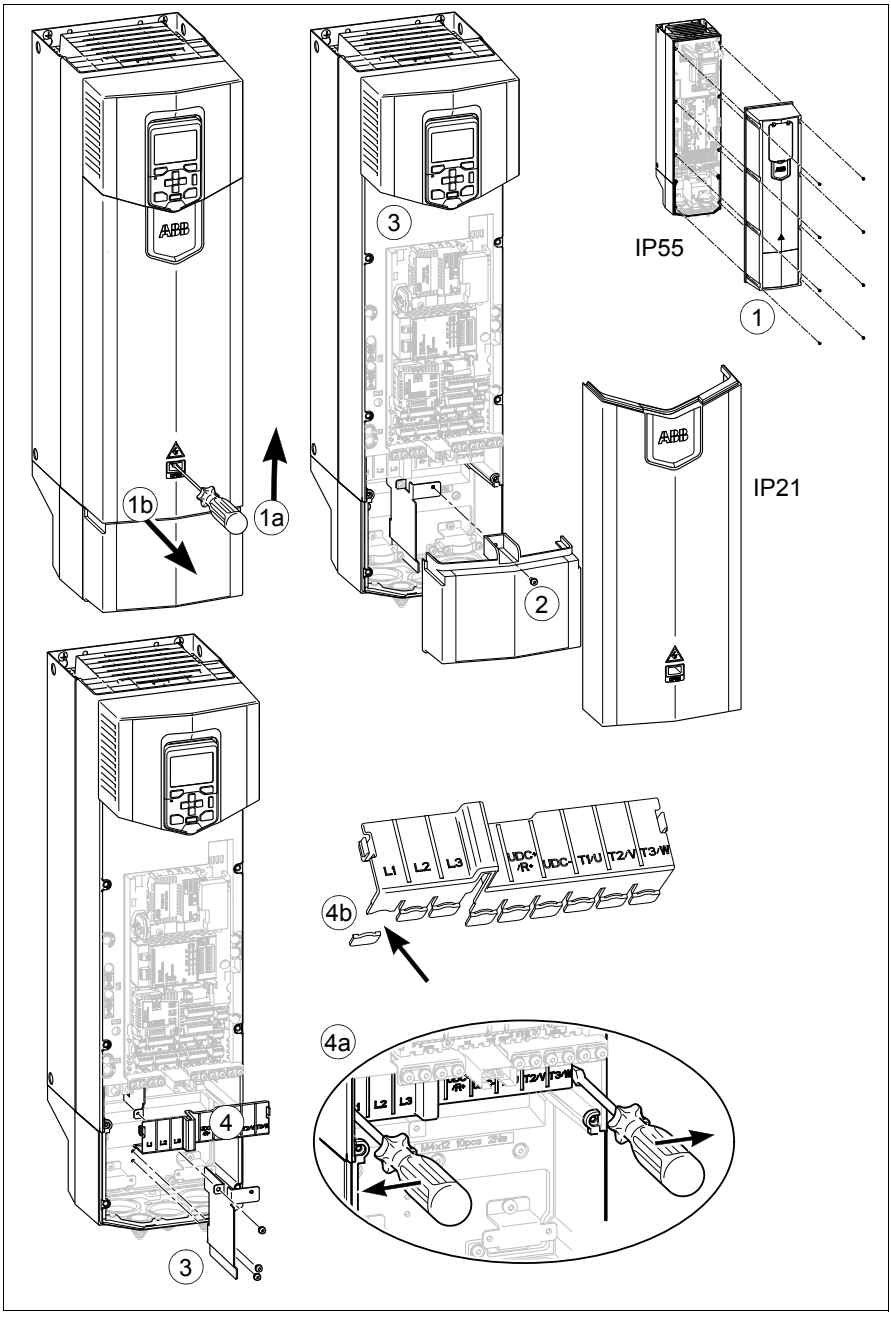
	L1, L2, L3, T1/U, T2/V, T3/W, R-, R+/UDC+, UDC (N·m)	⏚ (N·m)
R1	0.6	1.8
R2	0.6	1.8
R3	1.7	1.8

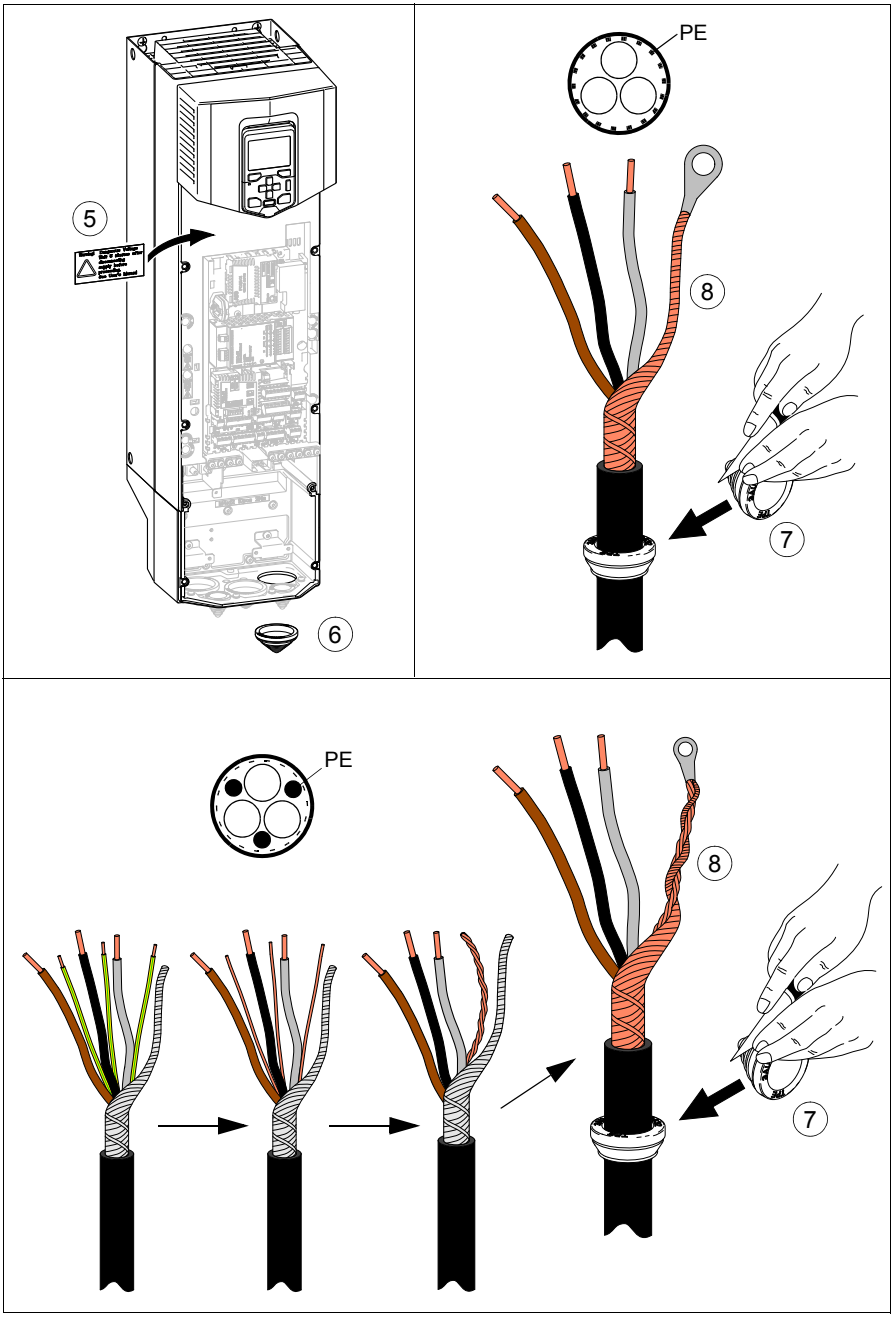

11

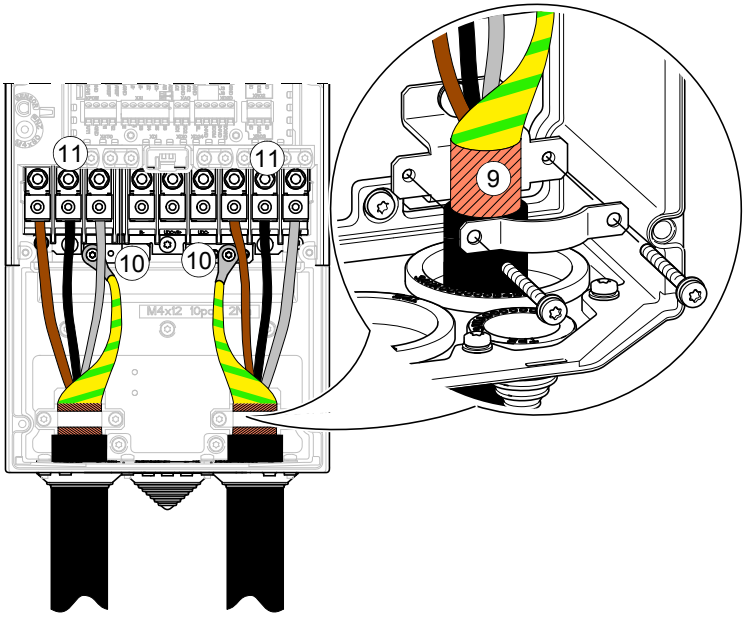
Connection procedure for frames R4 and R5

1. Remove the front cover. IP21 units: Release the retaining clip with a screwdriver (a) and lift the cover from the bottom outwards (b).
2. IP21 units: Remove the cable entry box cover by undoing the mounting screw.
3. Remove the EMC shroud that separates the input and output cabling.
4. Remove the shroud on the power cable terminals by releasing the clips and lifting the shroud up from the sides with a screwdriver (a). Knock out holes in the shroud for the cables to be installed (b).
5. Attach the residual voltage warning sticker in the local language next to the control unit top.
6. For IP55 drives: Remove rubber grommets from the lead-through plate for the cables to be connected.
7. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Slide the cables through the holes of the bottom plate and attach the grommets to the holes.
8. Prepare the ends of the input power and motor cables as illustrated in the figure. **Note**: Bare shield will be grounded 360 degrees under the grounding clamp.
9. Ground the cable shields 360 degrees under the grounding clamps.
10. Connect the twisted cable shields to the grounding terminals.
11. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals and the phase conductors of the motor cable to the T1/U, T2/V and T3/W terminals. Tighten the screws to the torque given in the figure below. **Note for frame R5:** For easier installation, the power cable terminals can be removed by undoing their mounting nuts. Fasten the terminals back to their place by tightening the mounting nuts.
12. Install the control cable grounding shelf.
13. Units with option +D150: Slide the brake resistor cable through the brake resistor and control cable clamp assembly. Connect the conductors to the R+ and R- terminals and tighten to the torque given in the figure.
14. Reinstall the shroud on the power terminals.
15. Reinstall the EMC shroud separating the input and output cabling.
16. Secure the cables outside the unit mechanically. Install the rubber grommets to the unused lead-through plate holes.

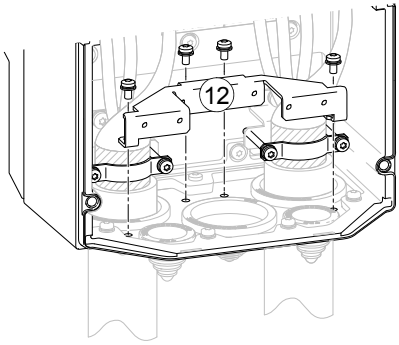
Note: For US cable conduit installation, see the quick installation guide. In case of a cable lug installation, use UL listed cable lugs and tools to agree with UL requirements. See page *155*.

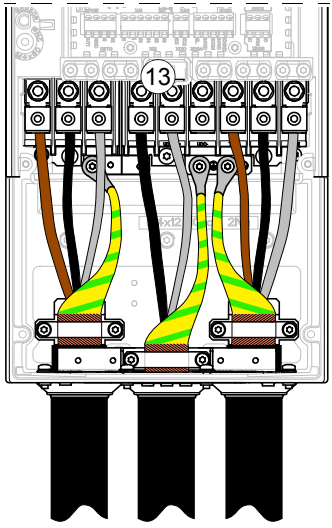

IP55
1
3
1b
1a
2
IP21
4b
L1
L2
L3
UDC+
/R+
UDC-
T1/U
T2/V
T3/W
4a
4
3


5
6
PE
8
7
PE
8
7



	L1, L2, L3, T1/U, T2/V, T3/W (N·m)		R-, R+/UDC+, UDC- (N·m)		⏚ (N·m)
		⬡		⬡	
R4	3.3	-	15	6	2.9
R5	15	6	30	24	2.9

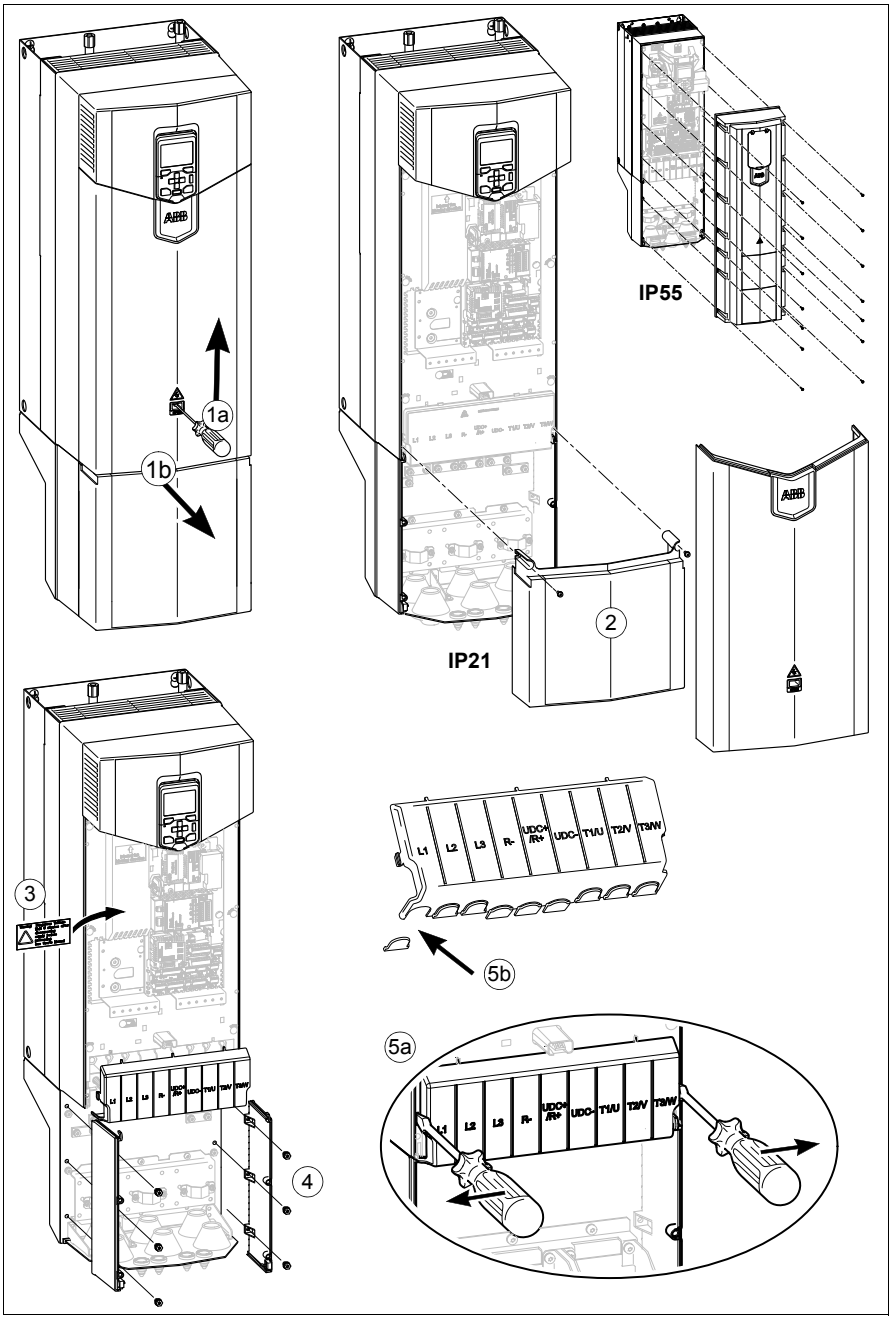


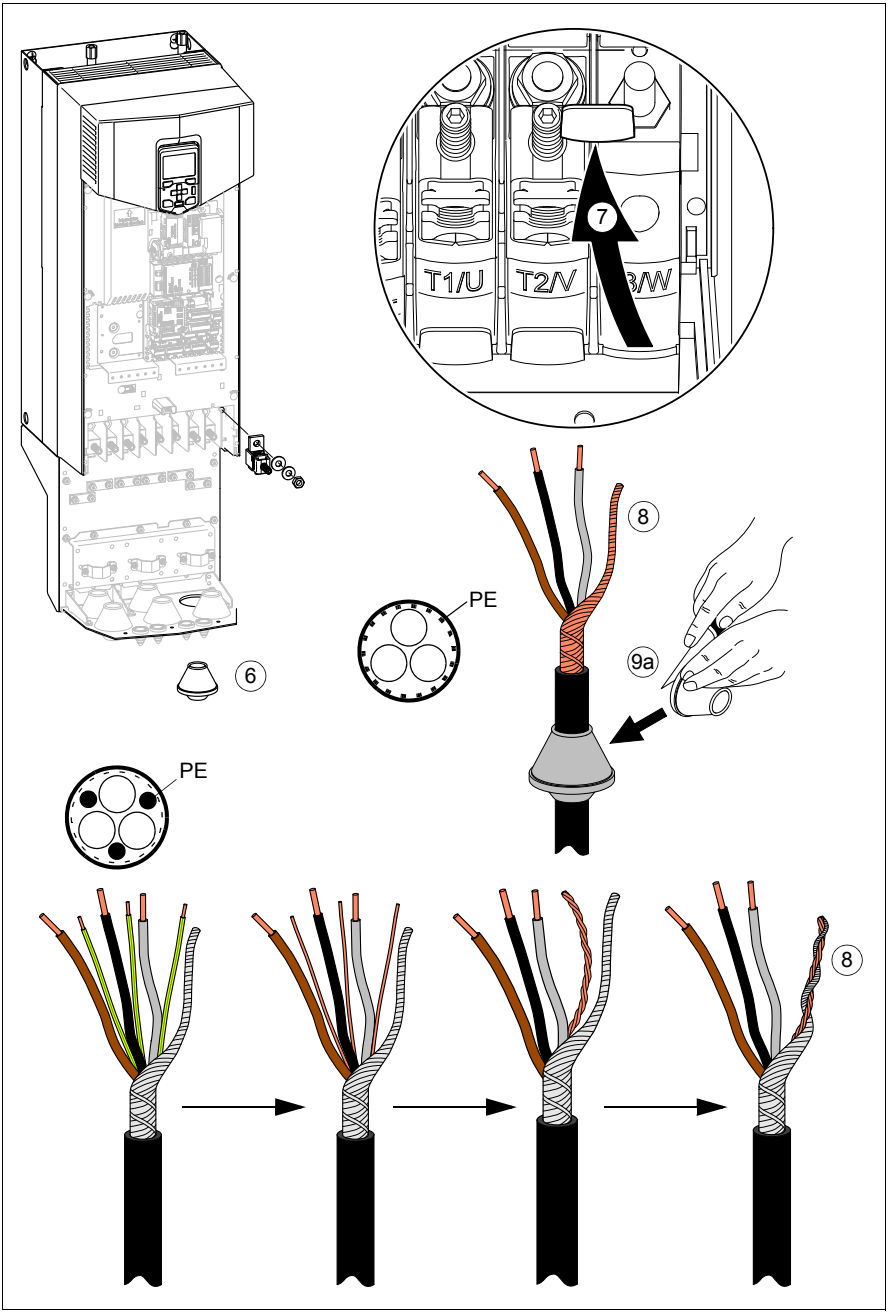


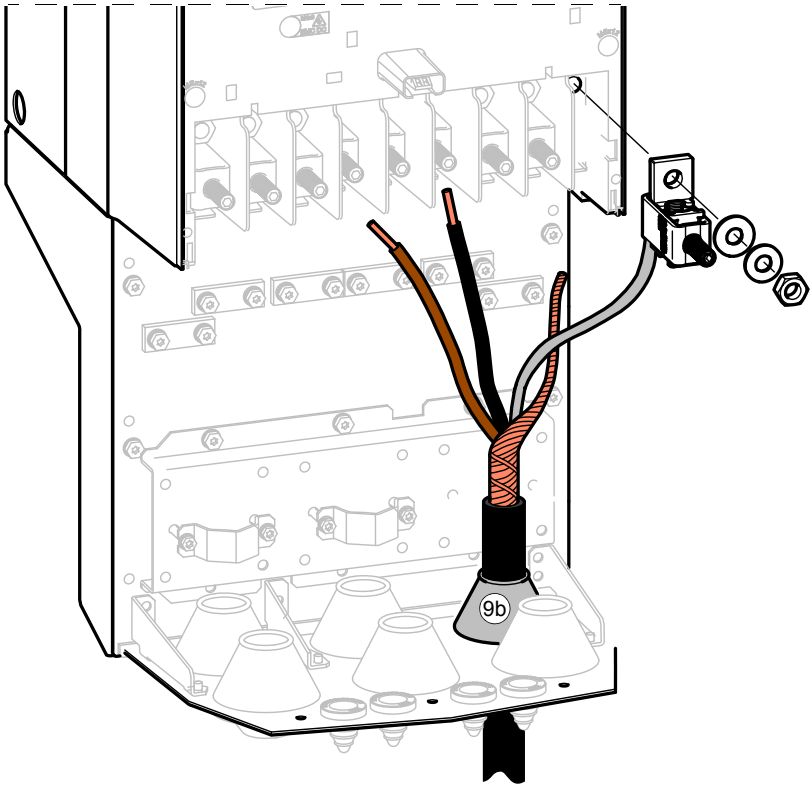
Connection procedure for frames R6 and R9

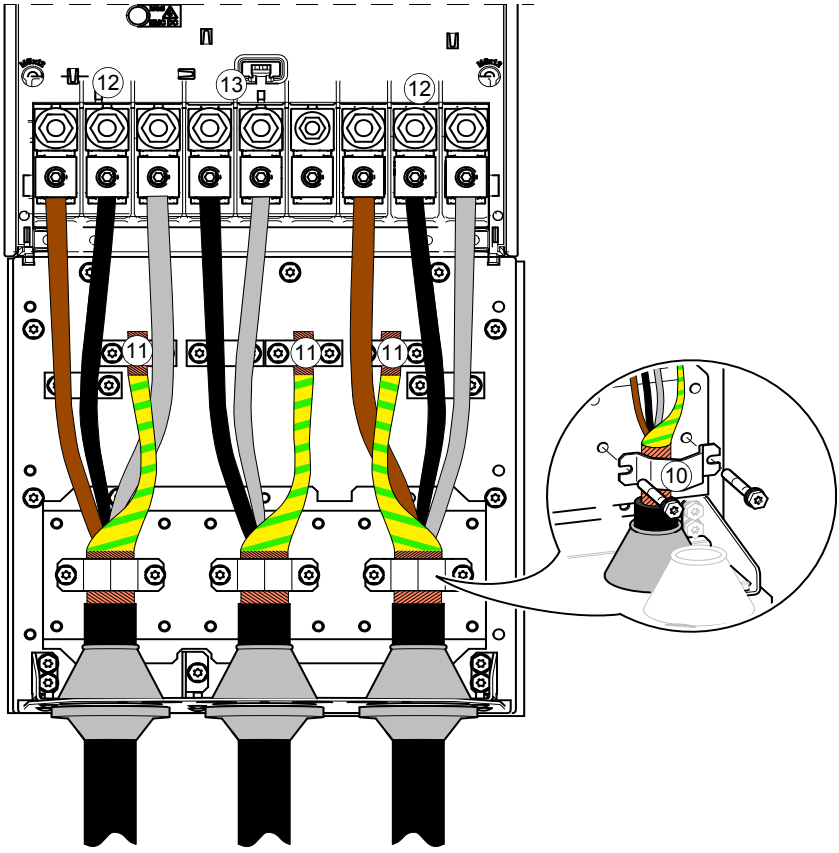
1. Remove the front cover: For IP21 drives: Release the retaining clip with a screwdriver (a) and lift the cover from the bottom outwards (b).
2. For IP21 drives: Remove the cable entry box cover by undoing the mounting screws.
3. Attach the residual voltage warning sticker in the local language next to the control unit.
4. Remove the side plates of the cable entry box by undoing the mounting screws.
5. Remove the shroud on the power cable terminals by releasing the clips on the sides with a screwdriver and lifting (a). If parallel cables are installed, knock out holes for the cables (b).
6. For IP55 drives: Remove the rubber grommets from the lead-through plate for the cables to be connected.
7. Knock out the shrouds on the power cable terminals for the cables to be installed.
8. Prepare the ends of the input power and motor cables as illustrated in the figure. **Note**: Bare shield will be grounded 360 degrees under the clamp.
9. Cut adequate holes into the rubber grommets (a). Slide the grommets onto the cables. Slide the cables through the holes of the bottom plate and attach the grommets to the holes (b).
10. Tighten the clamp onto the stripped part of the cable.
11. Fasten the twisted shields of the cables under the grounding clamps.
12. Connect the phase conductors of the input cable to the L1, L2 and L3 terminals and the phase conductors of the motor cable to the T1/U, T2/V and T3/W terminals. Tighten the screws to the torque given in the figure. **Note**: The phase connectors are detachable.
13. Units with option +D150: Connect the brake resistor cable conductors to the R+ and R- terminals.
14. If parallel cables are installed, install the grounding shelves for them. Repeat steps 8 to 14.
15. Reinstall the shroud on the power terminals.
16. Reinstall the side plates of the cable entry box.
17. Install the control cable grounding shelf in the cable entry box.
18. Secure the cables outside the unit mechanically. Install the rubber grommets to the unused lead-through plate holes.

Note: For US cable conduit installation, see the quick installation guide. In case of a cable lug installation, use UL listed cable lugs and tools to agree with UL requirements. See page *155*.


1a
1b
IP55
IP21
2
3
4
5a
5b
L1
L2
L3
R-
UDC+/R+
UDC-
T1/U
T2/V
T3/W

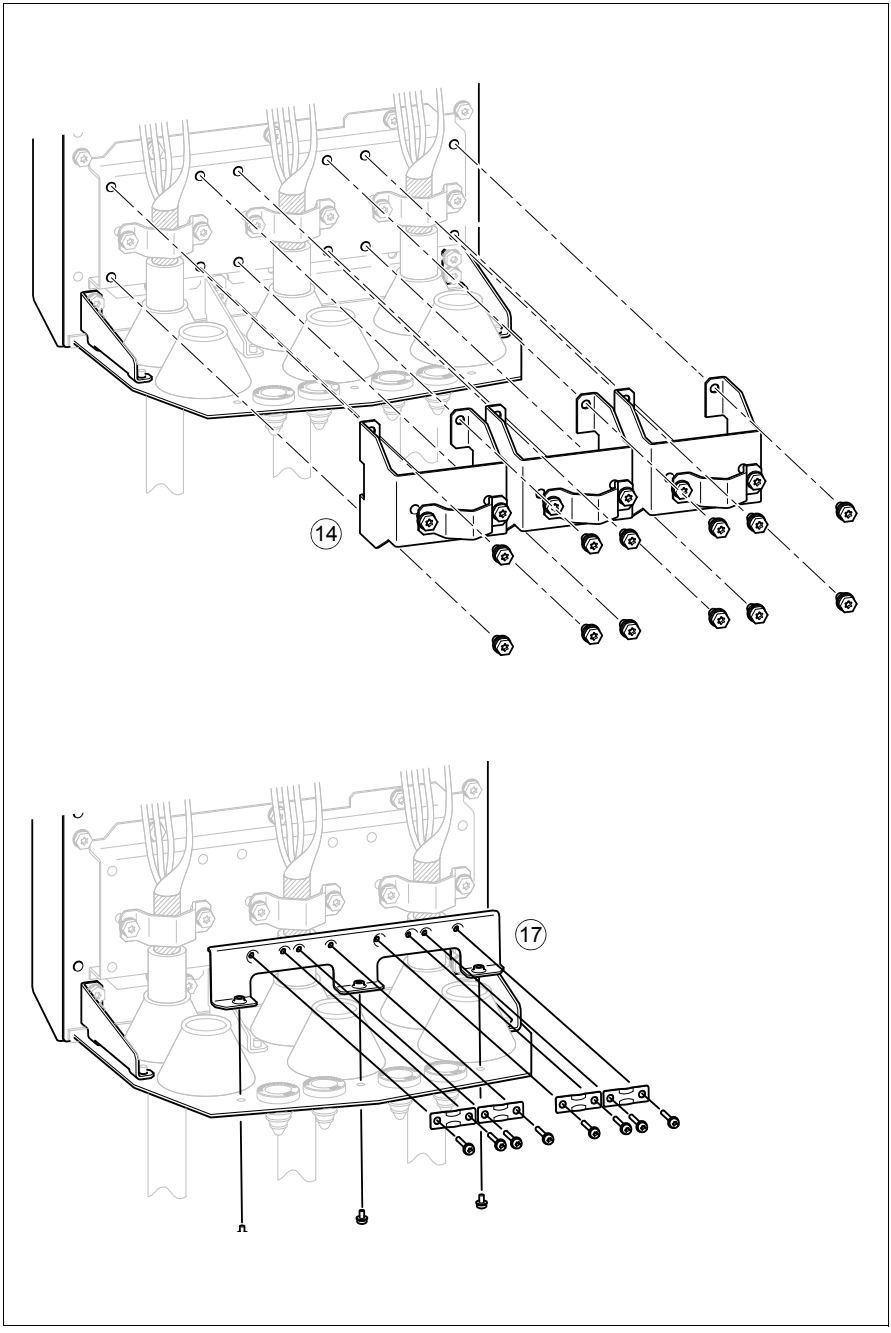

T1/U
T2/V
7
8
9a
6
PE
PE
8


9b



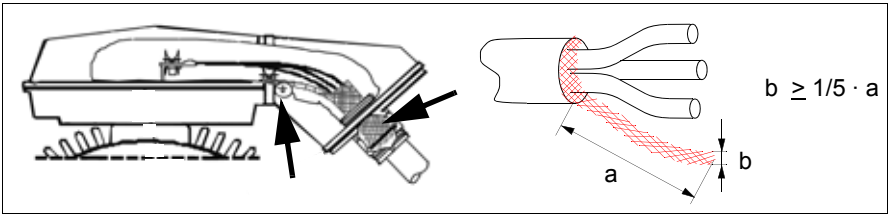
Frame	L1, L2, L3, T1/U, T2/V, T3/W				R-, R+/UDC+, UDC-				⏚
	T (Wire screw)		*T* (Terminal nut)		*T* (Wire screw)		*T* (Terminal nut)		*T*
	M…	N·m	M...	N·m	M…	N·m	M…	N·m	N·m
R6	M10	30	M8	24	M8	20	M8	20	9.8
R7	M10	40 (30*)	M8	24	M10	30	M10	30	9.8
R8	M10	40	M10	24	M10	40	M8	24	9.8
R9	M12	70	M10	24	M12	70	M8	24	9.8

* for 525…690 V drives


14
17

Grounding the motor cable shield at the motor end

Always ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the lead-through of the motor terminal box, or ground the flattened twisted shield (width ≥ 1/5 · length).



DC connection

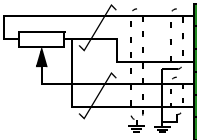
The UDC+ and UDC- terminals are intended for common DC configurations of a number of drives, allowing regenerative energy from one drive to be utilized by the other drives in motoring mode. Contact your local ABB representative for further instructions.

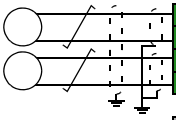
Connecting the control cables

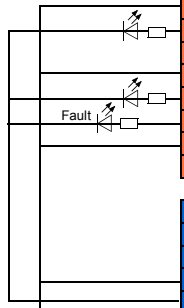
See section *Default I/O connection diagram* below for the default I/O connections of the Factory macro of ACS880 primary control program. For other macros and control programs, see the firmware manual. Connect the cables as described under *Control cable connection procedure* on page *104*.

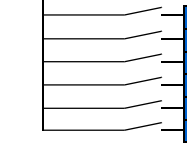
Default I/O connection diagram

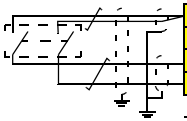
Wire sizes:
0.5 … 2.5 mm^2 (24…12 AWG)
Tightening torques: 0.5 N·m (5 lbf·in) for both stranded and solid wiring.











XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference** 0(2)…10 V, R_{in} > 200 kohm [1]
5	AI1-	
6	AI2+	By default not in use. 0(4)…20 mA, R_{in} > 100 ohm [2]
7	AI2-	
J1	J1	AI1 current/voltage selection jumper
J2	J2	AI2 current/voltage selection jumper
XAO	Analog outputs	
1	AO1	**Motor speed rpm** 0…20 mA, R_L < 500 ohm
2	AGND	
3	AO2	**Motor current** 0…20 mA, R_L < 500 ohm
4	AGND	
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
J3	J3	Drive-to-drive link termination switch
XRO1, XRO2, XRO3	Relay outputs	
1	NC	**Ready** 250 V AC / 30 V DC 2 A
2	COM	
3	NO	
1	NC	**Running** 250 V AC / 30 V DC 2 A
2	COM	
3	NO	
1	NC	**Faulted(-1)** 250 V AC / 30 V DC 2 A
2	COM	
3	NO	
XD24	Digital interlock	
1	DIIL	By default not in use.
2	+24VD	+24 V DC 200 mA [3]
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA [3]
5	DIOGND	Digital input/output ground
J6		Ground selection switch
XDIO	Digital input/outputs	
1	DIO1	Output: Ready
2	DIO2	Output: Running
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	Forward (0) / Reverse (1)
3	DI3	Reset
4	DI4	Acceleration & deceleration select [4]
5	DI5	Constant speed 1 (1 = On)
6	DI6	By default not in use.
XSTO	Safe torque off	
1	OUT1	Safe torque off. Both circuits must be closed for the drive to start.
2	SGND	
3	IN1	
4	IN2	
X12	Safety functions module connection	
X13	Control panel connection	
X205	Memory unit connection	

See the next page for the notes.

Notes:

[1] Current [0(4)…20 mA, R_{in} > 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected with jumper J1. Change of setting requires reboot of control unit.

[2] Current [0(4)…20 mA, R_{in} > 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected with jumper J2. Change of setting requires reboot of control unit.

[3] Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.

[4] 0 = open, 1 = closed

DI4	Ramp times according to
0	Parameters 23.12 and 23.13
1	Parameters 23.14 and 23.15

Further information on the usage of the connectors and jumpers is given in the sections below. See also section *Control unit/board (ZCU-11/ZCON-11) connection data* on page *157*.

Jumpers and switches

Jumper/ Switch	Description	Positions
J1 (AI1)	Determines whether analog input AI1 is used as a current or voltage input.	Current (I)
		Voltage (U)
J2 (AI2)	Determines whether analog input AI2 is used as a current or voltage input.	Current (I)
		Voltage (U)
J3	Drive-to-drive link termination. Must be set to terminated position when the drive is the last unit on the link.	Bus is terminated.
		Bus is not terminated.
J6	Common digital input ground selection switch. Determines whether DICOM is separated from DIOGND (ie, common reference for digital inputs floats). See *Ground isolation diagram* on page *159*.	DICOM and DIOGND connected (default).
		DICOM and DIOGND separated.

External power supply for the control unit (XPOW)

External +24 V (2 A) power supply for the control unit can be connected to terminal block XPOW. Using an external supply is recommended if

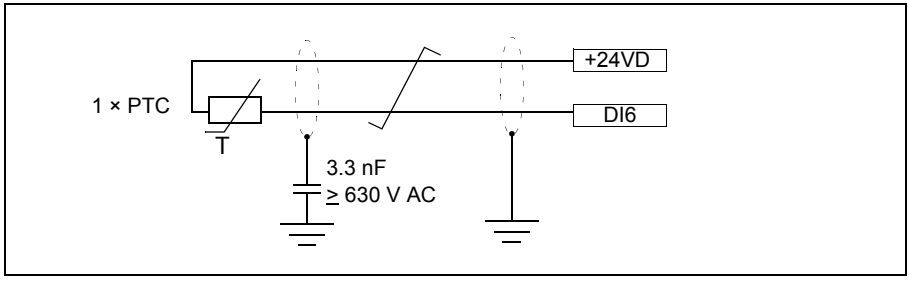
- the control board needs to be kept operational during input power breaks, for example, due to continuous fieldbus communication
- immediate restart is needed after power breaks (that is, no control board power up delay is allowed).

DIIL input (XD24:1)

The DIIL input can be selected as the source of, for example, an emergency stop command or an external event. See the firmware manual for more information.

DI6 (XDI:6) as PTC sensor input

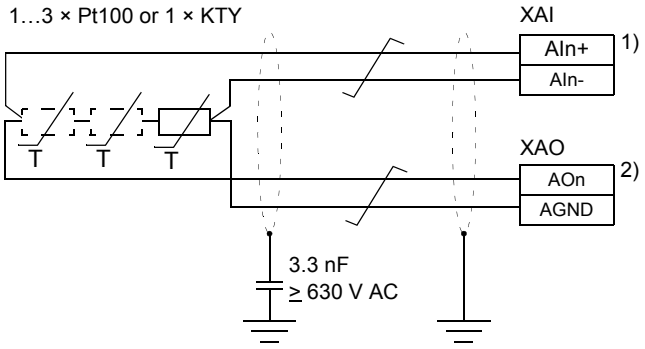
A PTC sensor can be connected to this input for motor temperature measurement as follows. The sensor can alternatively be connected to FEN-xx encoder interface module. Do not connect both ends of the cable shield directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected. See the firmware manual for parameter settings.



WARNING! As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfill the requirement, the I/O board terminals must be protected against contact and must not be connected to other equipment or the temperature sensor must be isolated from the I/O terminals.

AI1 and AI2 as Pt100 and KTY84 sensor inputs (XAI, XAO)

Three Pt100 sensors or one KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. (Alternatively, you can connect the KTY to FEN-11 analog /I/O extension module or FEN-xx encoder interface module.) Do not connect both ends of the cable shields directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected.



1) Set the input type to voltage with switch J1 for analog input AI1or with J2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group **12 Standard AI**.
2) Select the excitation mode in parameter group **13 Standard AO**.

WARNING! As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfill the requirement, the I/O board terminals must be protected against contact and must not be connected to other equipment or the temperature sensor must be isolated from the I/O terminals.

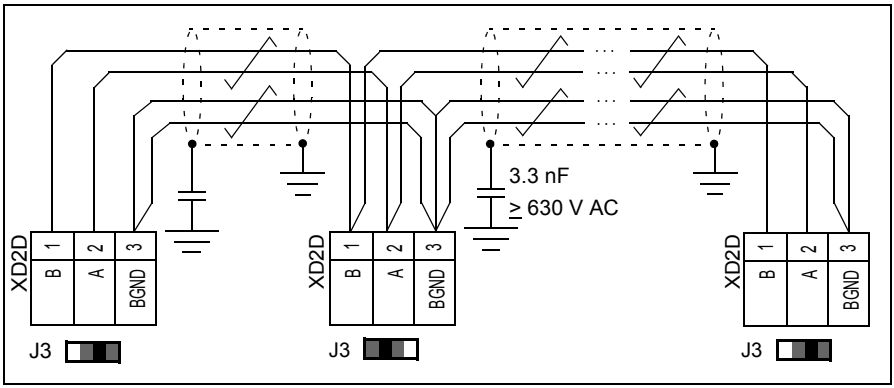
Drive-to-drive link (XD2D)

The drive-to-drive link is a daisy-chained RS-485 transmission line that allows basic master/follower communication with one master drive and multiple followers.

Set termination activation jumper J3 (see section *Jumpers and switches* above) next to this terminal block to the ON position on the drives at the ends of the drive-to-drive link. On intermediate drives, set the jumper to the OFF position.

Use shielded twisted-pair cable (~100 ohm, for example, PROFIBUS-compatible cable) for the wiring. For best immunity, high quality cable is recommended. Keep the cable as short as possible; the maximum length of the link is 50 meters (164 ft). Avoid unnecessary loops and running the cable near power cables (such as motor cables).

The following diagram shows the wiring of the drive-to-drive link.



Safe torque off (XSTO)

For the drive to start, both connections (OUT1 to IN1 and IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuitry to the drive. See page *189*.

Safety functions (X12)

See section *Implementing the Safety functions (option +Q973)* on page *71*, and *FSO-11 user's manual* (3AUA0000097054 [English]).

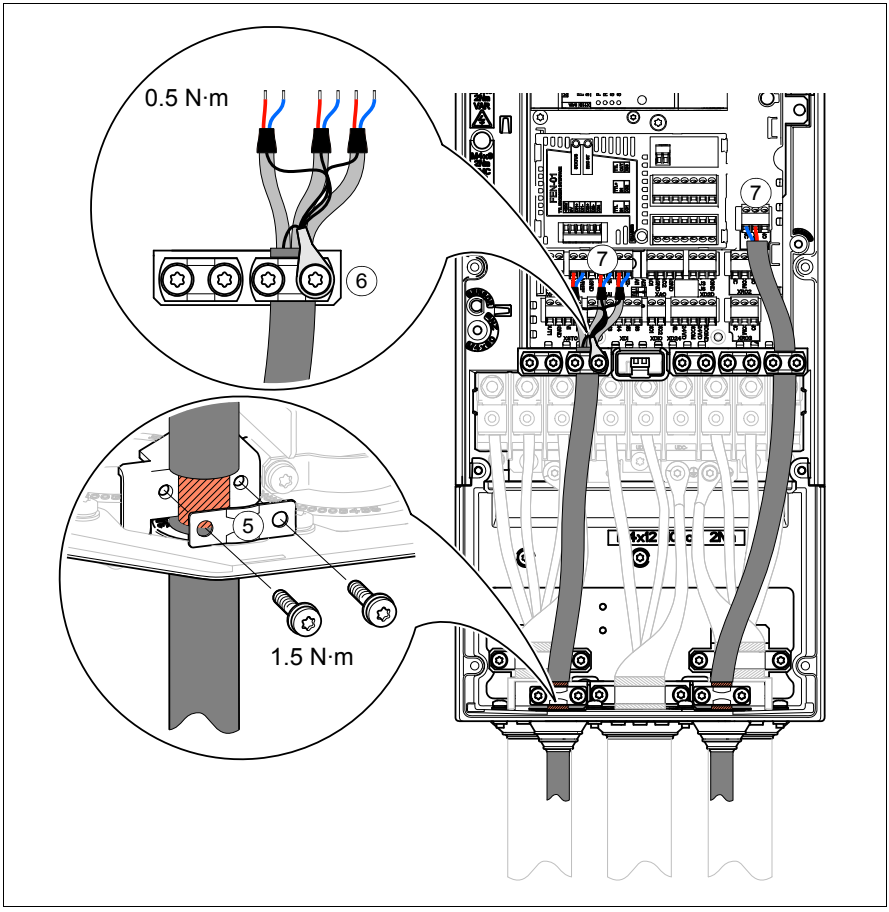
Control cable connection procedure

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front cover(s). See section *Connecting the power cables* starting from page *82*.
3. Cut adequate holes into the rubber grommets and slide the grommets onto the cables. Slide the cables through the holes of the bottom plate and attach the grommets to the holes.
4. Route the cables as shown on page *105*.
5. Ground the outer shields of all control cables 360 degrees at a grounding clamp in the cable entry box, see page *105*. Tighten the clamp to 1.5 N·m (13 lbf·in). Keep the shields continuous as close to the terminals of the control unit as possible. Secure the cables mechanically at the clamps below the control unit. Frames R1 to R3: Ground also the pair-cable shields and grounding wires at the cable entry box grounding clamp.
6. Frames R4 to R9: Ground the pair-cable shields and all grounding wires to the clamp below the control unit, see page *105*.
7. Connect the conductors to the appropriate terminals (see page *99)* of the control unit and tighten to 0.5 N·m (5 lbf·in).

Note:

- Leave the other ends of the control cable shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.
- Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.


0.5 N·m
6
7
7
5
1.5 N·m

Connecting a PC

Connect a PC to the drive with an USB data cable (USB Type A <-> USB Type Mini-B) as follows:

1. Lift the USB connector cover from bottom upwards.
2. Insert the USB cable Mini-B plug in the control panel USB connector.
3. Insert the USB cable A-plug in the USB connector of the PC. -> The panel displays: USB connected.

Chaining a control panel to several drives

A control panel can be chained to control several drives with standard Ethernet cables as follows:

1. Set the parameters of group **49 Panel port communication** in ACS880 primary control program for each drive.
2. Connect a cable to the control panel RJ-45 connector.
3. Connect the other end of the cable to the left-hand side RJ-45 connector in the control panel housing of the first drive.
4. Connect another cable to the right-hand side RJ-45 connector in the control panel housing of the first drive.
5. Connect the other end of the cable to the left-hand side RJ-45 connector in the control panel housing of the second drive and so on.
6. In the last drive, move the switch in the control panel housing upwards.

IP55 (UL Type 12) drives

To preserve the degree of protection:

- Remove the drive front cover.
- Put the cables through the control cable lead-throughs.
- Connect the cables as described above.
- Install the front cover.

Installing optional modules

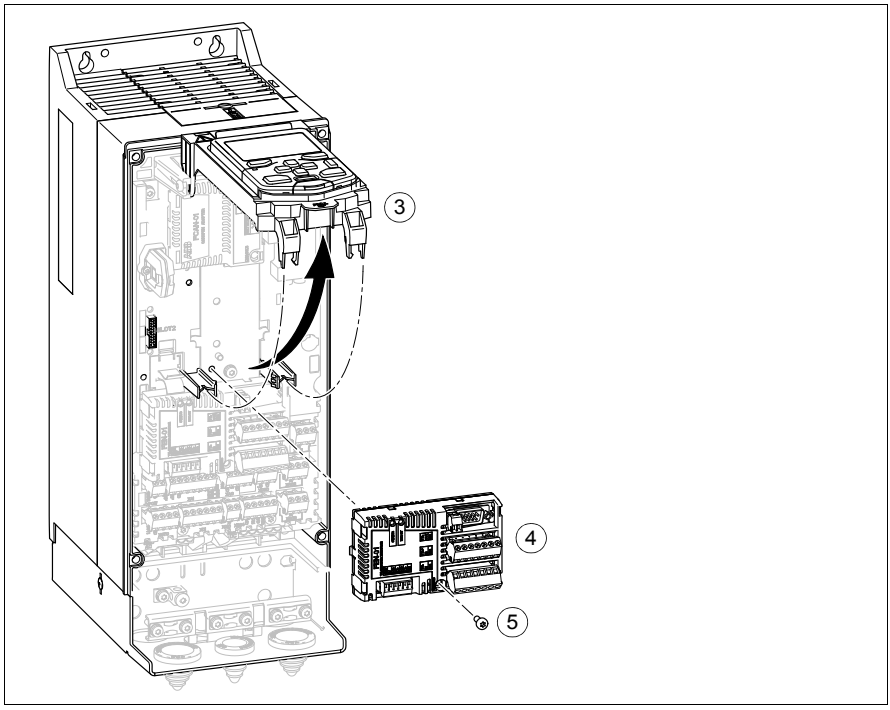
Note: In frames R1 and R2, 90° connector cannot be used in Slot 1. In other frames, there is 50 to 55 mm free space for the connector and its cable available on Slots 1, 2 and 3.

Mechanical installation of I/O extension, fieldbus adapter and pulse encoder interface modules

See page *31* for the available slots for each module. Install the optional modules as follows:

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front cover (see the section *Connecting the power cables* starting from page *82*.
3. Frames R1 to R3: Pull the control panel mounting platform upwards to gain access to the optional module slots.
4. Insert the module carefully into its position on the control unit.
5. Fasten the mounting screw. **Note:** The screw tightens the connections and grounds the module. It is essential for fulfilling the EMC requirements and for proper operation of the module.



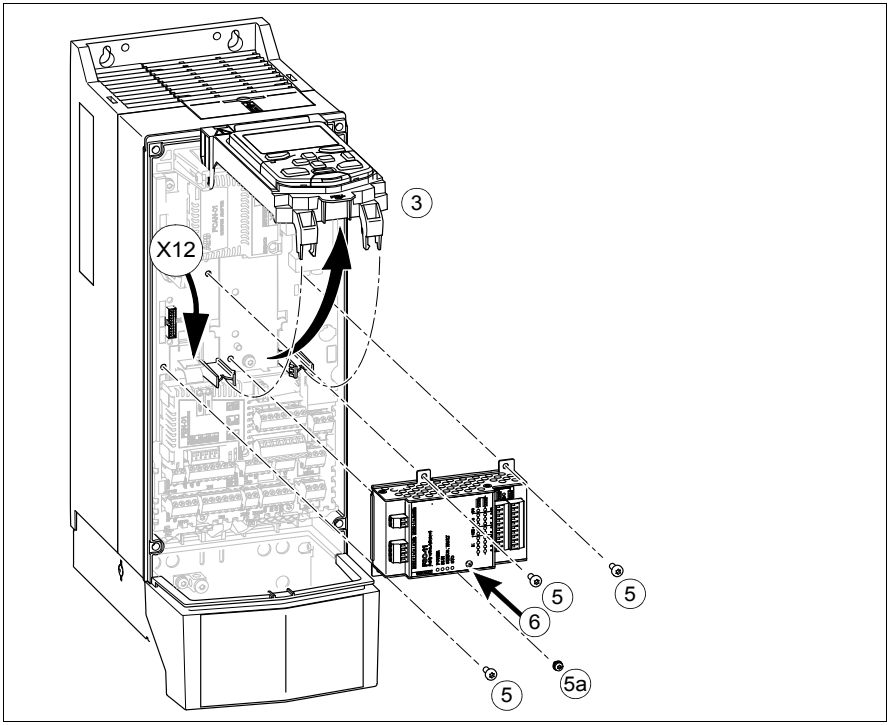
Mechanical installation of safety functions modules

The safety functions module can be inserted into Slot 2 on the control unit or, in frames R7 to R9, also next to the control unit.

Installation procedure into Slot 2

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

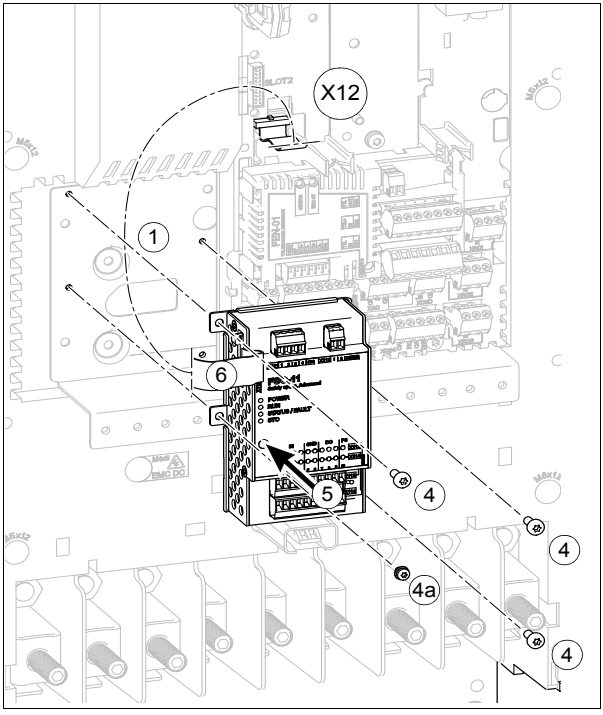
1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front cover (see the section *Connecting the power cables* on page *82*).
3. Frames R1 to R3: Pull the control panel mounting platform upwards to gain access to the optional module slots.
4. Insert the module carefully into its position on the control unit.
5. Attach the module with four screws. **Note:** The grounding screw (a) is essential for fulfilling the EMC requirements and for proper operation of the module.
6. Tighten the grounding screw of the electronics.
7. Connect the data communication cable to the data connection slot of the module and to connector X12 on the drive control unit.



Installation next to the control unit in frames R7 to R9

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front cover (see page *93*).
3. Insert the module carefully into its position.
4. Attach the module with four screws. **Note:** Correct installation of the grounding screw (a) is essential for fulfilling the EMC requirements and for proper operation of the module.
5. Tighten the grounding screw of the electronics.
6. Connect the data communication cable to the data connection slot of the module and to connector X12 on the drive control unit.



Wiring the modules

See the appropriate optional module manual for specific installation and wiring instructions. See page 105 for the routing of the cables.

7

Installation checklist

What this chapter contains

This chapter contains a list for checking the mechanical and electrical installation of the drive.

Checklist

Check the mechanical and electrical installation of the drive before start-up. Go through the checklist together with another person.

WARNING! Only qualified electricians are allowed to carry out the work described below. Follow the complete safety instructions of the drive. Ignoring the safety instructions can cause injury or death. Open the main disconnector of the drive and lock it to open position. Measure to ensure that the drive is not powered.

☑	**Check that …**
☐	The ambient operating conditions meet the specification in chapter *Technical data*.
☐	If the drive will be connected to an IT (ungrounded) supply network: Optional EMC filters of type +E200 and +E202 have been disconnected. Consult ABB for the instructions.
☐	If the drive has been stored over one year: The electrolytic DC capacitors in the DC link of the drive have been reformed. See page *130*
☐	There is an adequately sized protective earth (ground) conductor between the drive and the switchboard.

☑	**Check that …**
☐	There is an adequately sized protective earth (ground) conductor between the motor and the drive.
☐	All protective earth (ground) conductors have been connected to the appropriate terminals and the terminals have been tightened (pull conductors to check).
☐	The supply voltage matches the nominal input voltage of the drive. Check the type designation label.
☐	The input power cable has been connected to appropriate terminals, the phase order is right, and the terminals have been tightened (pull conductors to check).
☐	Appropriate supply fuses and disconnector have been installed.
☐	The motor cable has been connected to appropriate terminals, the phase order is right, and the terminals have been tightened (pull conductors to check).
☐	The brake resistor cable (if present) has been connected to appropriate terminals, and the terminals have been tightened (pull conductors to check).
☐	The motor cable (and brake resistor cable, if present) has been routed away from other cables.
☐	No power factor compensation capacitors have been connected to the motor cable.
☐	The control cables (if any) have been connected to the control unit.
☐	If a drive bypass connection will be used: The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked (cannot be closed simultaneously).
☐	There are no tools, foreign objects or dust from drilling inside the drive.
☐	Drive and motor connection box covers are in place.
☐	The motor and the driven equipment are ready for start-up.

8

Start-up

What this chapter contains

This chapter describes the start-up procedure of the drive.

Startup procedure

1. Run setup of the drive control program according to the start-up instructions given in *Quick start-up guide for ACS880 primary control program* or in the firmware manual.
2. Validate the Safe torque off function according to the instructions given in chapter *Safe Torque off function* on page *189*.
3. Validate the Safety functions (option +Q973) as described in *FSO-11 user's manual* (3AUA0000097054 [English]).

9

Fault tracing

What this chapter contains

This chapter describes the fault tracing possibilities of the drive.

LEDs

Where	LED	Color	When the LED is lit
Control panel mounting platform	POWER	Green	Control unit is powered and +15 V is supplied to the control panel.
	FAULT	Red	Drive in fault state.

Warning and fault messages

See the firmware manual for the descriptions, causes and remedies of the drive control program warning and fault messages.

10

Maintenance

What this chapter contains

This chapter contains preventive maintenance instructions.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. The table below lists the routine maintenance intervals recommended by ABB.

The recommended maintenance intervals and component replacements are based on specified operational and environmental conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance. For more information on maintenance counters, see the firmware manual. Consult your local ABB Service representative for more details on the maintenance. On the Internet, go to http://www.abb.com/drivesservices.

Interval	Maintenance	Instruction
Every year	Checking main cooling fan, tightness of terminals, dustiness, corrosion, temperature and quality of supply voltage and other maintenance actions according to drive maintenance counter.	Maintenance if needed. See section *Heatsink*.
	Checking the maintenance counter of IGBT-run cycles.	Frames R1 to R5: If needed, contact ABB for replacement of IGBT power semiconductors. Frames R6 and R7: If needed, contact ABB for replacement of IGBT power semiconductors and ZGAD board(s). Frames R8 and R9: If needed, contact ABB for replacement of IGBT power semiconductors and ZGAD and ZGAB boards.
Every year when stored	Capacitor reforming	See *Reforming the capacitors*.
Every 3 years	Auxiliary cooling fan replacement	See *Fans*.
Every 6 years. **Every 3 years** if ambient temperature is higher than 40 °C (104 °F) or continuous operation or according to the maintenance counter.	Main cooling fan replacement	See *Fans*.
Every 9 years. E**very 6 years** if ambient temperature is higher than 40 °C (104 °F) or cyclic heavy load or continuous nominal load or according to the maintenance counter.	Frames R1 to R3: ZINT board replacement. Frames R4 to R5: ZMAC board replacement.	Contact ABB.
	Frames R6 to R9: Capacitor and discharging resistor replacement.	Contact ABB.
Every 9 years	Control panel battery replacement	See *Replacing the control panel battery*.
	ZCON board battery replacement	Contact ABB.

Interval	Maintenance	Instruction
Every 12 years. **Every 9 years** if ambient temperature is higher than 40 °C (104 °F).	Frames R4 to R9: ZINT board replacement. All frames: Replacement of ZPOW, ZCON and ZINP board and flat ribbon cables.	Contact ABB.

Heatsink

The module heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. When necessary, clean the heatsink as follows.

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING! Use a vacuum cleaner with antistatic hose and nozzle. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the cooling fan(s). See section *Fans* below.
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. **Note:** If there is a risk of dust entering adjoining equipment, perform the cleaning in another room.
4. Refit the cooling fan.

Fans

The lifespan of the cooling fans of the drive depend on the running time of the fan, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after a fan replacement.

Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Replacing the main cooling fan of frames R1 to R3

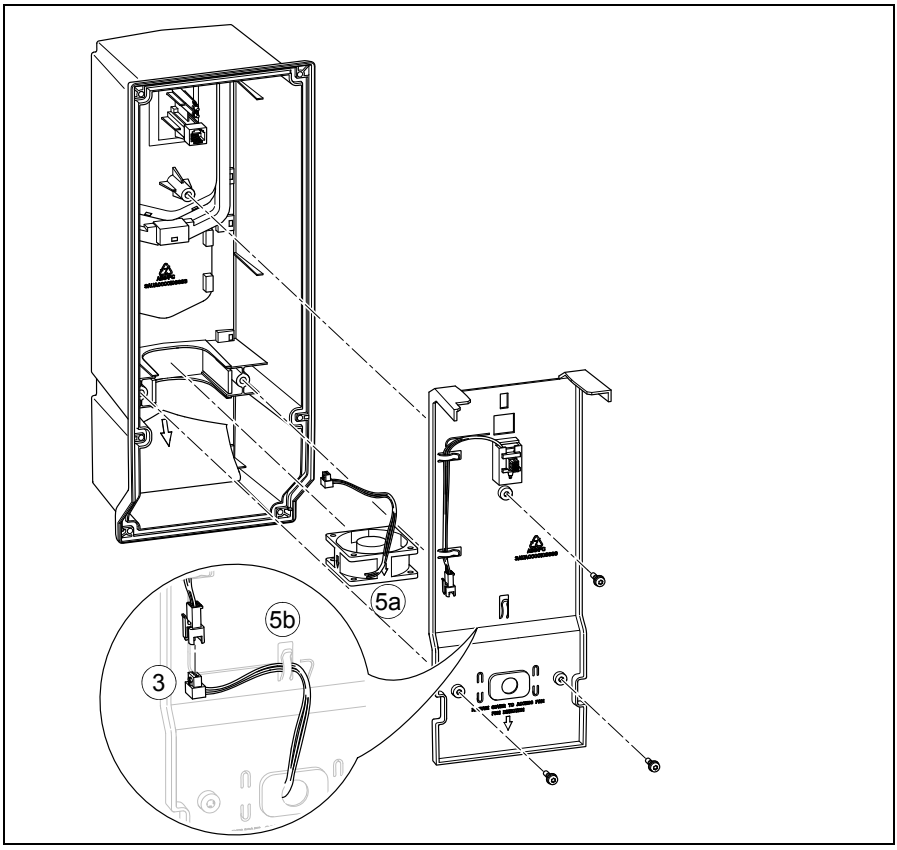
WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Release the retaining clip by pushing with a flat screwdriver and turning to the right.
3. Lift the fan cassette up.
4. Install the new fan in reverse order.

Replacing the auxiliary cooling fan of IP55 frames R1 to R3

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front cover by undoing the mounting screws at the sides.
3. Unplug the fan power supply wires.
4. Lift the fan off.
5. Install the new fan in reverse order. Make sure that the arrow (a) on the fan points down. **Note**: Bundle the wires under the clip (b) otherwise the cover will not fit properly.



Replacing the main cooling fan of frames R4 and R5

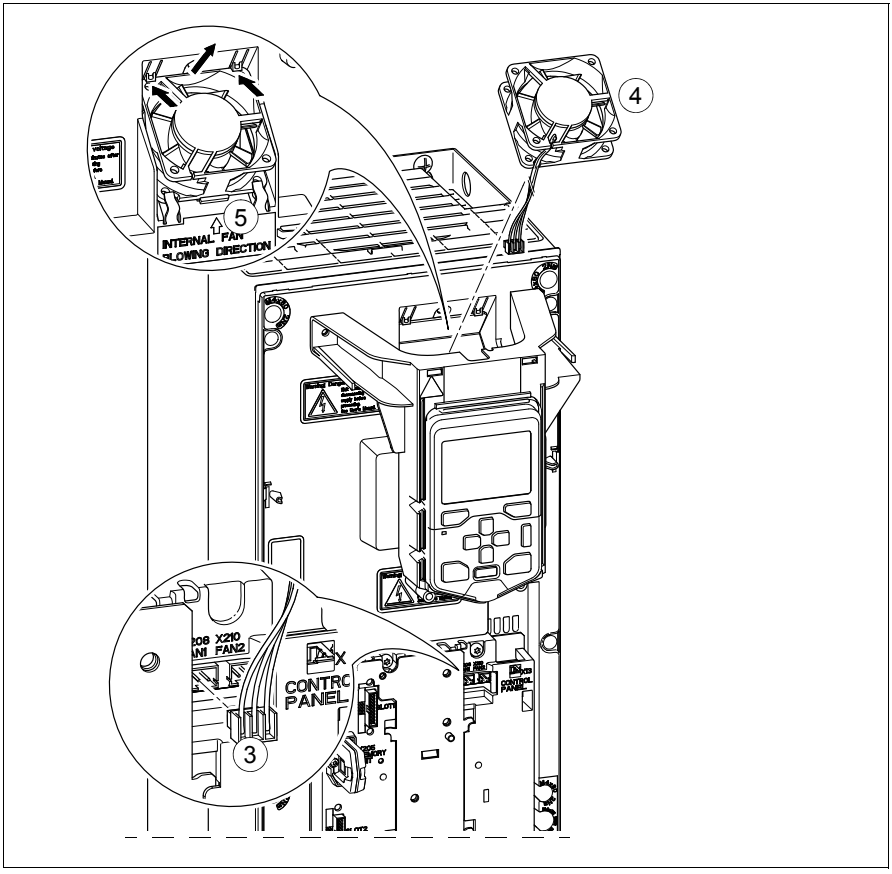
WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Lift the fan mounting plate up from the front edge.
3. Unplug the power supply wires.
4. Lift the fan mounting plate off.
5. Remove the fan from the mounting plate.
6. Install the new fan in reverse order.

Replacing the auxiliary cooling fan of frame R4 and IP55 frame R5 and IP21 frame R5 types ACS880-01-xxxx-07

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

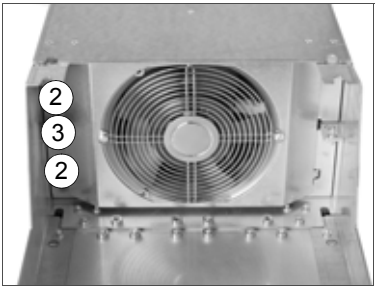
1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front cover.
3. Unplug the fan power supply wires.
4. Lift the fan up.
5. Install the new fan in reverse order. Make sure that the arrow in the fan points to the direction marked on the drive frame.

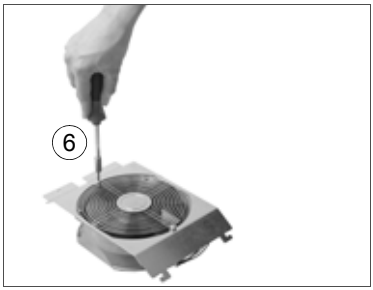


Replacing the main cooling fan of frames R6 to R8

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Undo the mounting screws of the fan mounting plate (view from bottom below).
3. Pull the fan mounting plate down from the side edge.
4. Unplug the power supply wires.
5. Lift the fan mounting plate off.
6. Remove the fan from the mounting plate.
7. Install the new fan in reverse order.

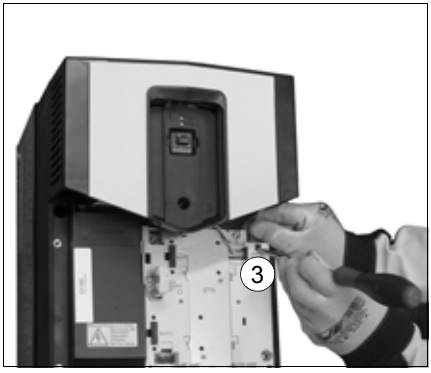


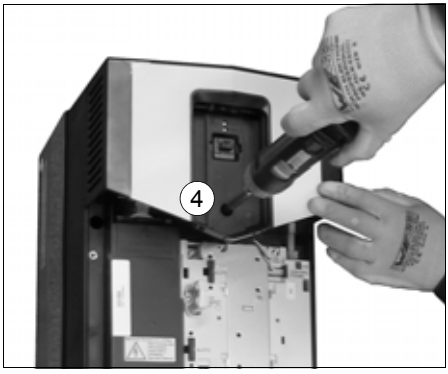


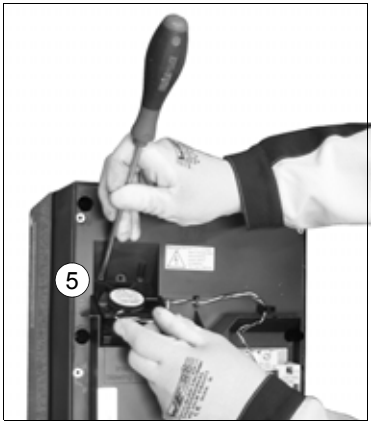
Replacing the auxiliary cooling fan of frames R6 to R9

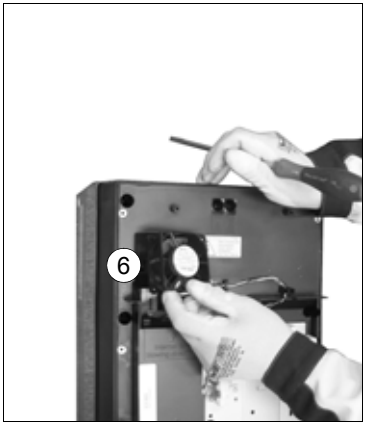
WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the lower front cover (see page *91*)
3. Unplug the control panel power supply wires from the control unit terminal X13 and the auxiliary cooling fan power supply wires from the terminal X208:FAN2.
4. Remove the upper front cover.
5. Release the retaining clips.
6. Lift the fan up.
7. Install the new fan in reverse order. Make sure that the arrow on the fan points up.





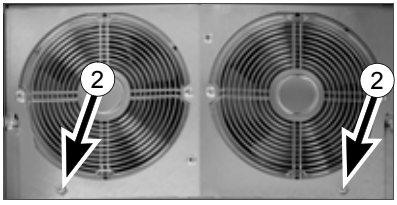


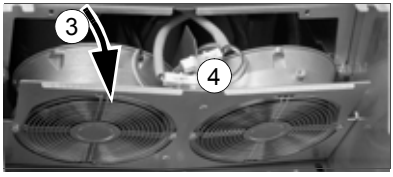


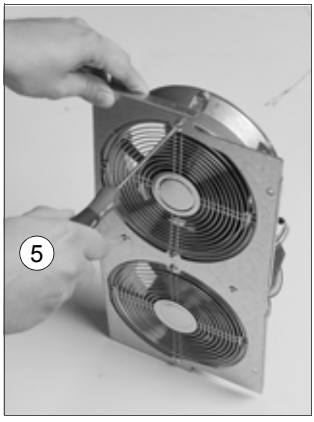
Replacing the cooling fans of frame R9

WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Undo the two mounting screws of the fan mounting plate (view from drive bottom below).
3. Turn the mounting plate downwards.
4. Disconnect the fan power supply wires.
5. Remove the fan mounting plate.
6. Remove the fan by undoing the two mounting screws.
7. Install the new fan in reverse order.







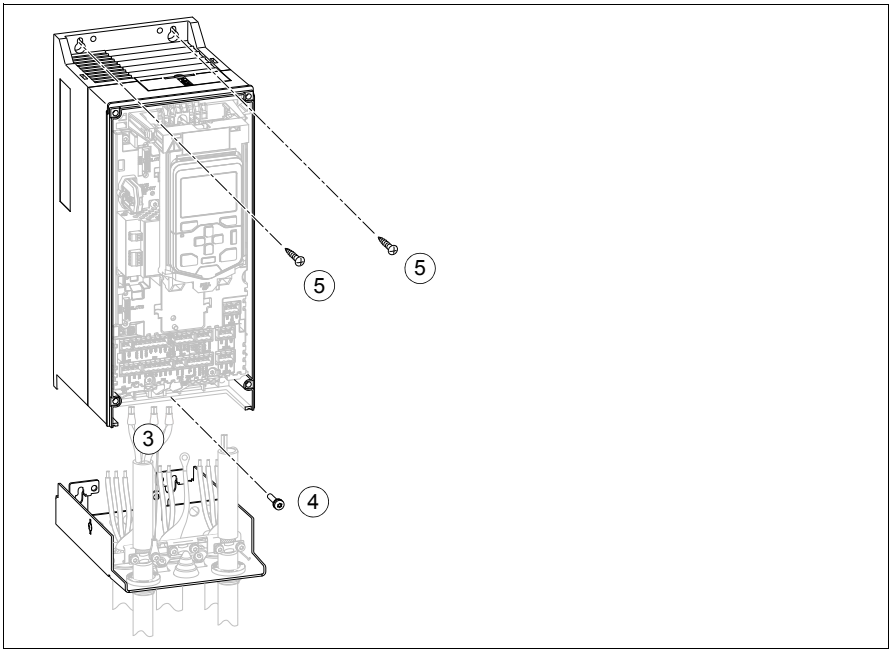
Replacing the drive (frames R1 to R5)

This section gives instructions for replacing the drive module without the cable entry box. You can replace the drive with or without its cable entry box. The latter option allows you to leave the cables installed (except from disconnecting the conductors).

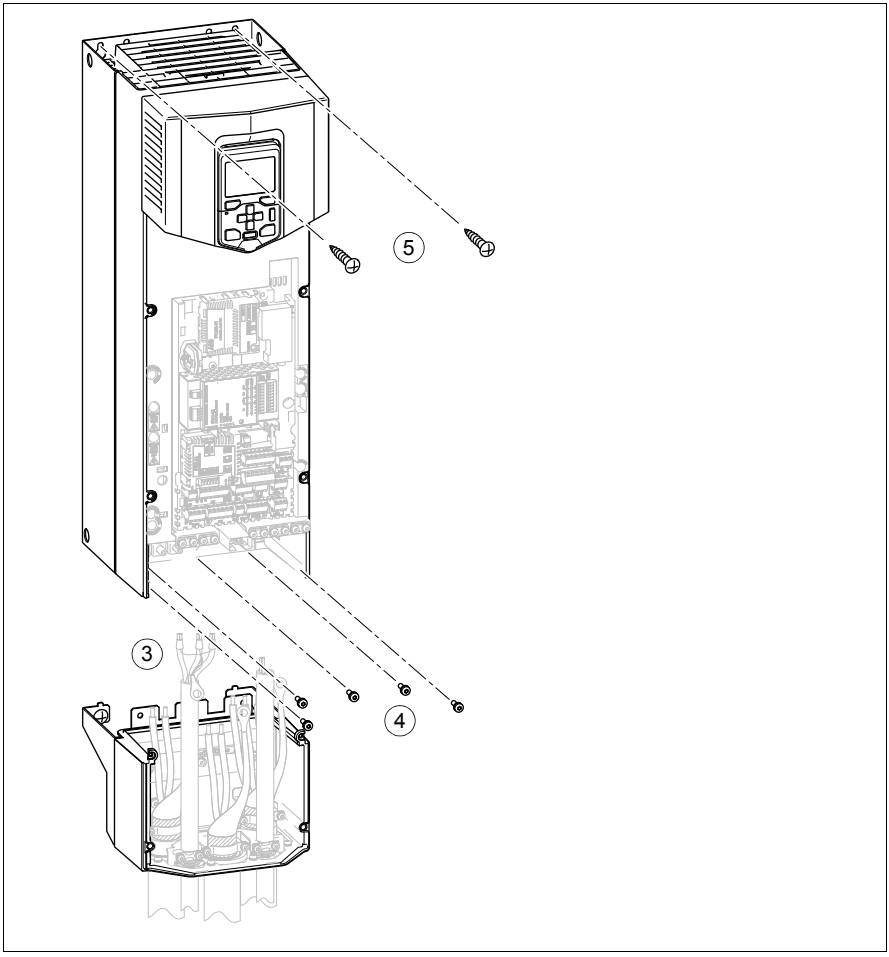
WARNING! Follow the safety instructions, page *14*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Disconnect the drive from the power line. Lock the main disconnecting device and ensure by measuring that there is no voltage.
2. Remove the front covers. See section *Connection procedure for frames R1 to R3* on page *83* or *Connection procedure for frames R4 and R5* on page *87*.
3. Disconnect the power and control cables.
4. Undo the screw(s) that fasten drive module to the cable entry box.
5. Undo the two screws that fasten drive module to the wall from top.
6. Lift the drive off.

The principle of undoing the mounting screws in frames R1 to R3 is shown below (view of an IP21 unit).



The principle of undoing the mounting screws in frames R4 and R5 is shown below (view of an IP21 unit).



Capacitors

The drive intermediate DC circuit employs several electrolytic capacitors. Their lifespan depends on the operating time of the drive, loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

In frames R1 to R3, the capacitors are integrated to the ZINT board and in frames R4 to R5 to the ZMAC board. In frames R6 to R8, the capacitors are separate.

Capacitor failure is usually followed by damage to the unit and an input cable fuse failure, or a fault trip. Contact ABB if capacitor failure is suspected. Replacements are available from ABB. Do not use other than ABB specified spare parts.

Reforming the capacitors

The capacitors must be reformed if the drive has been stored for a year or more. See page *33* for information on finding out the manufacturing date. For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]).

Memory unit

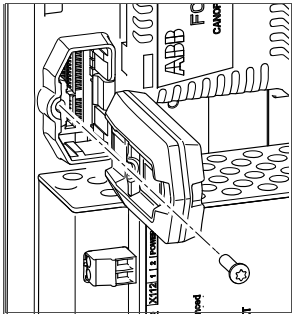
When a drive is replaced, the parameter settings can be retained by transferring the memory unit from the defective drive to the new drive. The memory unit is located on the control unit, see page *32*.

WARNING! Do not remove or insert a memory unit when the drive is powered or the control unit is powered from an external power source.

After power-up, the drive will scan the memory unit. If different parameter settings are detected, they are copied to the drive. This may take several minutes.

Replacing the memory unit

Undo the memory unit mounting screw and take the memory unit up. Replace the unit in reverse order. **Note**: There is a spare screw next to the memory unit slot.



Replacing the control panel battery

The battery is housed on the rear of the control panel. Replace with a new CR 2032 battery. Dispose the old battery according to local disposal rules or applicable laws.

Replacing safety functions modules (FSO-11, option +Q973)

Do not repair safety functions modules. Replace a faulty module with a new one as described under *Mechanical installation of safety functions modules* on page *109*.

11

Technical data

What this chapter contains

This chapter contains the technical specifications of the drive, for example, the ratings, sizes and technical requirements, provisions for fulfilling the requirements for CE and other markings.

Ratings

The nominal ratings for the drives with 50 Hz and 60 Hz supply are given below. The symbols are described below the table.

IEC RATINGS									
Drive type ACS880-01-	Frame size	Input rating	Max. current	Output ratings					
				Nominal use		Light-overload use		Heavy-duty use	
		I_{1N}	I_{max}	I_N	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	kW	A	kW	A	kW
U_N = 208…240 V									
04A6-2	R1	4.6	6.3	4.6	0.75	4.4	0.75	3.7	0.55
06A6-2	R1	6.6	7.8	6.6	1.1	6.3	1.1	4.6	0.75
07A5-2	R1	7.5	11.2	7.5	1.5	7.1	1.5	6.6	1.1
10A6-2	R1	10.6	12.8	10.6	2.2	10.1	2.2	7.5	1.5
16A8-2	R2	16.8	18.0	16.8	4.0	16.0	4.0	10.6	2.2
24A3-2	R2	24.3	28.6	24.3	5.5	23.1	5.5	16.8	4.0
031A-2	R3	31.0	41	31	7.5	29.3	7.5	24.3	5.5
U_N = 380…415 V									
02A4-3	R1	2.4	3.1	2.4	0.75	2.3	0.75	1.8	0.55
03A3-3	R1	3.3	4.1	3.3	1.1	3.1	1.1	2.4	0.75
04A0-3	R1	4.0	5.6	4.0	1.5	3.8	1.5	3.3	1.1
05A6-3	R1	5.6	6.8	5.6	2.2	5.3	2.2	4.0	1.5
07A2-3	R1	7.2	9.5	7.2	3.0	6.8	3.0	5.6	2.2
09A4-3	R1	9.4	12.2	9.4	4.0	8.9	4.0	7.2	3.0
12A6-3	R1	12.6	16.0	12.6	5.5	12.0	5.5	9.4	4.0
017A-3	R2	17	21	17	7.5	16	7.5	12.6	5.5
025A-3	R2	25	29	25	11	24	11	17	7.5
032A-3	R3	32	42	32	15	30	15	25	11
038A-3	R3	38	54	38	18.5	36	18.5	32	15.0
045A-3	R4	45	64	45	22	43	22	38	19
061A-3	R4	61	76	61	30	58	30	45	22
072A-3	R5	72	104	72	37	68	37	61	30
087A-3	R5	87	122	87	45	83	45	72	37
105A-3	R6	105	148	105	55	100	55	87	45
145A-3	R6	145	178	145	75	138	75	105	55
169A-3	R7	169	247	169	90	161	90	145	75
206A-3	R7	206	287	206	110	196	110	169	90
246A-3	R8	246	350	246	132	234	132	206	110
293A-3	R8	293	418	293	160	278	160	246*	132
363A-3	R9	363	498	363	200	345	200	293	160
430A-3	R9	430	545	430	250	428	250	363**	200

IEC RATINGS									
Drive type ACS880-01-	**Frame size**	**Input rating**	**Max. current**	**Output ratings**					
				Nominal use		**Light-overload use**		**Heavy-duty use**	
		I_{1N}	I_{max}	I_N	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	**A**	**A**	**kW**	**A**	**kW**	**A**	**kW**
U_N = 380…500 V									
02A1-5	R1	2.1	3.1	2.1	0.75	2.0	0.75	1.7	0.55
03A0-5	R1	3.0	4.1	3.0	1.1	2.8	1.1	2.1	0.75
03A4-5	R1	3.4	5.6	3.4	1.5	3.2	1.5	3.0	1.1
04A8-5	R1	4.8	6.8	4.8	2.2	4.6	2.2	3.4	1.5
05A2-5	R1	5.2	9.5	5.2	3.0	4.9	3.0	4.8	2.2
07A6-5	R1	7.6	12.2	7.6	4.0	7.2	4.0	5.2	3.0
11A0-5	R1	11.0	16.0	11.0	5.5	10.4	5.5	7.6	4.0
014A-5	R2	14	21	14	7.5	13	7.5	11	5.5
021A-5	R2	21	29	21	11	19	11.0	14	7.5
027A-5	R3	27	42	27	15	26	15	21	11
034A-5	R3	34	54	34	18.5	32	18.5	27	15.0
040A-5	R4	40	64	40	22	38	22	34	19
052A-5	R4	52	76	52	30	49	30	40	22
065A-5	R5	65	104	65	37	62	37	52	30
077A-5	R5	77	122	77	45	73	45	65	37
096A-5	R6	96	148	96	55	91	55	77	45
124A-5	R6	124	178	124	75	118	75	96	55
156A-5	R7	156	247	156	90	148	90	124	75
180A-5	R7	180	287	180	110	171	110	156	90
240A-5	R8	240	350	240	132	228	132	180	110
260A-5	R8	260	418	260	160	247	160	240*	132
361A-5	R9	361	542	361	200	343	200	302	200
414A-5	R9	414	542	414	250	393	250	361**	200

IEC RATINGS									
Drive type ACS880-01-	Frame size	Input rating	Max. current	Output ratings					
				Nominal use		Light-overload use		Heavy-duty use	
		I_{1N}	I_{max}	I_N	P_N	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}
		A	A	A	kW	A	kW	A	kW
U_N = 660…690 V									
07A3-7	R5	7.3	12.2	7.3	5.5	6.9	5.5	5.6	4
09A8-7	R5	9.8	18	9.8	7.5	9.3	7.5	7.3	5.5
14A2-7	R5	14.2	22	14.2	11	13.5	11	9.8	7.5
018A-7	R5	18	30	18	15	17	15	14.2	11
022A-7	R5	22	44	22	18.5	21	18.5	18	15
026A-7	R5	26	54	26	22	25	22	22	18.5
035A-7	R5	35	64	35	30	33	30	26	22
042A-7	R5	42	74	42	37	40	37	35	30
049A-7	R5	49	76	49	45	47	45	42	37
061A-7	R6	61	104	61	55	58	55	49	45
084A-7	R6	84	124	84	75	80	75	61	55
098A-7	R7	98	168	98	90	93	90	84	75
119A-7	R7	119	198	119	110	113	110	98	90
142A-7	R8	142	250	142	132	135	132	119	110
174A-7	R8	174	274	174	160	165	160	142	132
210A-7	R9	210	384	210	200	200	200	174	160
271A-7	R9	271	411	271	250	257	250	210	200

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NEMA RATINGS									
Drive type ACS880-01-	**Frame size**	**Input rating**	**Max. current**	**Output ratings**					
				Light-overload use			**Heavy-duty use**		
		I_{1N}	I_{max}	I_{Ld}	P_{Ld}		I_{Hd}	P_{Hd}	
		A	**A**	**A**	**kW**	**hp**	**A**	**kW**	**hp**
U_N = 208…240 V									
04A6-2	R1	4.6	6.3	4.4	0.75	1.0	3.7	0.55	0.75
06A6-2	R1	6.6	7.8	6.3	1.1	1.5	4.6	0.75	1.0
07A5-2	R1	7.5	11.2	7.1	1.5	2.0	6.6	1.1	1.5
10A6-2	R1	10.6	12.8	10.1	2.2	3.0	7.5	1.5	2.0
16A8-2	R2	16.8	18.0	16.0	4.0	5.0	10.6	2.2	3.0
24A3-2	R2	24.3	28.6	23.1	5.5	7.5	16.8	4.0	5.0
031A-2	R3	31.0	41	29.3	7.5	10	24.3	5.5	7.5
U_N = 440…480 V									
02A1-5	R1	2.1	3.1	2.1	0.75	1.0	1.7	0.55	0.75
03A0-5	R1	3.0	4.1	3.0	1.1	1.5	2.1	0.75	1.0
03A4-5	R1	3.4	5.6	3.4	1.5	2.0	3.0	1.1	1.5
04A8-5	R1	4.8	6.8	4.8	2.2	3.0	3.4	1.5	2.0
05A2-5	R1	5.2	9.5	5.2	3.0	3.0	4.8	1.5	2.0
07A6-5	R1	7.6	12.2	7.6	4.0	5.0	5.2	2.2	3.0
11A0-5	R1	11	16.0	11	5.5	7.5	7.6	4.0	5.0
014A-5	R2	14	21	14	7.5	10	11	5.5	7.5
021A-5	R2	21	29	21	11	15	14	7.5	10
027A-5	R3	27	42	27	15	20	21	11	15
034A-5	R3	34	54	34	18.5	25	27	15	20.0
040A-5	R4	40	64	40	22	30	34	18.5	25
052A-5	R4	52	76	52	30	40	40	22	30
065A-5	R5	65	104	65	37	50	52	30	40
077A-5	R5	77	122	77	45	60	65	37	50
096A-5	R6	96	148	96	55	75	77	45	60
124A-5	R6	124	178	124	75	100	96	55	75
156A-5	R7	156	247	156	90	125	124	75	100
180A-5	R7	180	287	180	110	150	156	90	125
240A-5	R8	240	350	240	132	200	180	110	150
260A-5	R8	260	418	260	132	200	240*	110	150
302A-5	R9	302	498	302	200	250	260	132	200
361A-5	R9	361	542	361	200	300	302	200	250
414A-5	R9	414	542	414	250	350	361**	200	300

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Definitions

U_N	Supply voltage range
I_{1N}	Nominal rms input current
I_N	Nominal output current (available continuously with no over-loading)
P_N	Typical motor power in no-overload use
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
P_{Ld}	Typical motor power in light-overload use
I_{max}	Maximum output current. Available for 10 seconds at start. then as long as allowed by drive temperature.
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes. * Continuous rms output current allowing 30% overload for 1 minute every 5 minutes. ** Continuous rms output current allowing 25% overload for 1 minute every 5 minutes.
P_{Hd}	Typical motor power in heavy-duty use

Note 1: The ratings apply at an ambient temperature of 40 °C (104 °F).

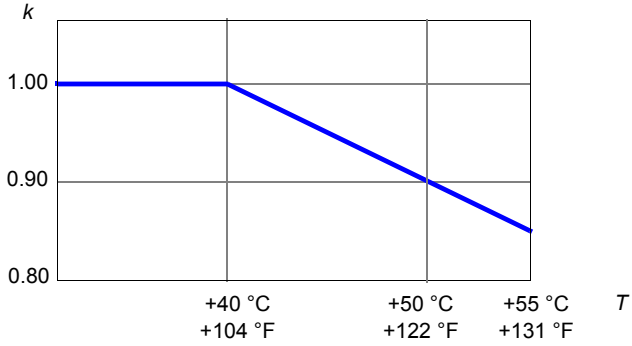
Note 2: To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

Derating

Ambient temperature derating

In the temperature range +40…55 °C (+104…131 °F), the rated output current is derated by 1% for every added 1 °C (1.8 °F). The output current can be calculated by multiplying the current given in the rating table by the derating factor (*k*):



Altitude derating

At altitudes from 1000 to 4000 m (3300 to 13123 ft) above sea level, the continuous output currents given above must be derated 1% for every 100 m (328 ft). For a more accurate derating, use the DriveSize PC tool.

Low noise control mode derating

When low noise drive control mode is used, the motor and braking powers are derated. Please, contact ABB for more information.

Fuses (IEC)

gG and aR fuses for protection against short-circuit in the input power cable or drive are listed below. Either fuse type can be used for frames R1 to R6 if it operates rapidly enough. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. For frames R7 to R9 ultra-rapid (aR) fuses must be used.

Note 1: See also *Implementing thermal overload and short-circuit protection* on page *69*.

Note 2: Fuses with higher current rating than the recommended ones must not be used.

Note 3: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

aR fuses (frames R1 to R9)

Ultrarapid (aR) fuses (one fuse per phase)								
Drive type ACS880-01-	Min. short-circuit current [1] (A)	Input current (A)	Fuse					
			A	A^2s	V	Manufacturer	Type	Type IEC 60263
U_N = 208…240 V								
04A6-2	30	4.6	16	48	690	Bussmann	170M1558	000
06A6-2	30	6.6	16	48	690	Bussmann	170M1558	000
07A5-2	30	7.5	16	48	690	Bussmann	170M1558	000
10A6-2	53	10.6	20	78	690	Bussmann	170M1560	000
16A8-2	65	16.8	25	130	690	Bussmann	170M1561	000
24A3-2	120	24.3	40	460	690	Bussmann	170M1563	000
031A-2	160	31.0	50	770	690	Bussmann	170M1564	000
U_N = 380…415 V								
02A4-3	65	2.4	50	770	690	Bussmann	170M1564	000
03A3-3	65	3.3	25	130	690	Bussmann	170M1561	000
04A0-3	65	4.0	25	130	690	Bussmann	170M1561	000
05A6-3	65	5.6	25	130	690	Bussmann	170M1561	000
07A2-3	65	7.2	25	130	690	Bussmann	170M1561	000
09A4-3	65	9.4	25	130	690	Bussmann	170M1561	000
12A6-3	65	12.6	25	130	690	Bussmann	170M1561	000

Ultrarapid (aR) fuses (one fuse per phase)								
Drive type ACS880-01-	**Min. short-circuit current [1] (A)**	**Input current (A)**	**Fuse**					
			A	**A^2s**	**V**	**Manufacturer**	**Type**	**Type IEC 60263**
017A-3	120	17	40	460	690	Bussmann	170M1563	000
025A-3	120	25	40	460	690	Bussmann	170M1563	000
032A-3	170	32	63	1450	690	Bussmann	170M1565	000
038A-3	170	38	63	1450	690	Bussmann	170M1565	000
045A-3	280	45	80	2550	690	Bussmann	170M1566	000
061A-3	380	61	100	4650	690	Bussmann	170M1567	000
072A-3	480	72	125	8500	690	Bussmann	170M1568	000
087A-3	480	87	125	8500	690	Bussmann	170M1568	000
105A-3	700	105	160	16000	690	Bussmann	170M1569	000
145A-3	700	145	200	28000	690	Bussmann	170M1569	000
169A-3	1280	169	315	46500	690	Bussmann	170M3817	1
206A-3	1280	206	315	46500	690	Bussmann	170M3817	1
246A-3	1520	246	350	68500	690	Bussmann	170M3818	1
293A-3	1810	293	400	105000	690	Bussmann	170M3819	1
363A-3	2620	363	550	190000	690	Bussmann	170M5811	2
430A-3	3010	430	630	275000	690	Bussmann	170M5812	2
U_N = 500 V								
02A1-5	65	2.1	25	130	690	Bussmann	170M1561	000
03A0-5	65	3.0	25	130	690	Bussmann	170M1561	000
03A4-5	65	3.4	25	130	690	Bussmann	170M1561	000
04A8-5	65	4.8	25	130	690	Bussmann	170M1561	000
05A2-5	65	5.2	25	130	690	Bussmann	170M1561	000
07A6-5	65	7.6	25	130	690	Bussmann	170M1561	000
11A0-5	65	11.0	25	130	690	Bussmann	170M1561	000
014A-5	120	14	40	460	690	Bussmann	170M1563	000
021A-5	120	21	40	460	690	Bussmann	170M1563	000
027A-5	170	27	63	1450	690	Bussmann	170M1565	000
034A-5	170	34	63	1450	690	Bussmann	170M1565	000
040A-5	280	40	80	2550	690	Bussmann	170M1566	000
052A-5	300	52	100	4650	690	Bussmann	170M1567	000
065A-5	480	65	125	8500	690	Bussmann	170M1568	000
077A-5	480	77	125	8500	690	Bussmann	170M1568	000
096A-5	700	96	160	16000	690	Bussmann	170M1569	000
124A-5	700	124	200	28000	690	Bussmann	170M1569	000
156A-5	1280	156	315	46500	690	Bussmann	170M3817	1
180A-5	1280	180	315	46500	690	Bussmann	170M3817	1
240A-5	1520	240	350	68500	690	Bussmann	170M3818	1

Ultrarapid (aR) fuses (one fuse per phase)								
Drive type ACS880-01-	**Min. short-circuit current [1] (A)**	**Input current (A)**	**Fuse**					
			A	**A^2s**	**V**	**Manufacturer**	**Type**	**Type IEC 60263**
260A-5	1810	260	400	105000	690	Bussmann	170M3819	1
361A-5	2620	361	550	190000	690	Bussmann	170M5811	2
414A-5	3010	414	630	275000	690	Bussmann	170M5812	2
U_N = 525…690 V								
07A3-7	40	7.3	16	48	690	Bussmann	170M1558	000
09A8-7	53	9.8	20	78	690	Bussmann	170M1560	000
14A2-7	94	14.2	32	270	690	Bussmann	170M1562	000
018A-7	120	18	40	460	690	Bussmann	170M1563	000
022A-7	160	22	50	770	690	Bussmann	170M1564	000
026A-7	160	26	50	770	690	Bussmann	170M1564	000
035A-7	170	35	63	1450	690	Bussmann	170M1565	000
042A-7	280	42	80	2550	690	Bussmann	170M1566	000
049A-7	280	49	80	2550	690	Bussmann	170M1566	000
061A-7	480	61	125	8500	690	Bussmann	170M1568	000
084A-7	700	84	160	16000	690	Bussmann	170M1569	000
098A-7	700	98	160	16000	690	Bussmann	170M1569	0
119A-7	700	119	200	15000	690	Bussmann	170M3815	1
142A-7	1000	142	250	28500	690	Bussmann	170M3816	1
174A-7	1280	174	315	46500	690	Bussmann	170M3817	1
210A-7	1610	210	400	74000	690	Bussmann	170M5808	2
271A-7	1610	271	400	74000	690	Bussmann	170M5808	2

gG fuses (frames R1 to R6)

Check on the fuse time-current curve to ensure the operating time of the fuse is below 0.5 seconds. Follow the local regulations.

gG fuses (one fuse per phase)								
Drive type ACS880-01…	**Min. short-circuit current[1)]**	**Input current**	**Fuse**					
	A	A	A	A^2s	V	Manufacturer	Type	IEC size
U_N = 208…240 V								
04A6-2	40	4.6	6	110	500	ABB	OFAF000H6	000
06A6-2	80	6.6	10	360	500	ABB	OFAF000H10	000
07A5-2	120	7.5	16	740	500	ABB	OFAF000H16	000
10A6-2	120	10.6	16	740	500	ABB	OFAF000H16	000
16A8-2	200	16.8	25	2500	500	ABB	OFAF000H25	000
24A3-2	350	24.3	40	7700	500	ABB	OFAF000H40	000
031A-2	400	31.0	50	16000	500	ABB	OFAF000H50	000
U_N = 380…415 V								
02A4-3	17	2.4	4	53	500	ABB	OFAF000H4	000
03A3-3	40	3.3	6	110	500	ABB	OFAF000H6	000
04A0-3	40	4.0	6	110	500	ABB	OFAF000H6	000
05A6-3	80	5.6	10	355	500	ABB	OFAF000H10	000
07A2-3	80	7.2	10	355	500	ABB	OFAF000H10	000
09A4-3	120	9.4	16	700	500	ABB	OFAF000H16	000
12A6-3	120	12.6	16	700	500	ABB	OFAF000H16	000
017A-3	200	17	25	2500	500	ABB	OFAF000H25	000
025A-3	250	25	32	4500	500	ABB	OFAF000H32	000
032A-3	350	32	40	7700	500	ABB	OFAF000H40	000
038A-3	400	38	50	15400	500	ABB	OFAF000H50	000
045A-3	500	45	63	21300	500	ABB	OFAF000H63	000
061A-3	800	61	80	37000	500	ABB	OFAF000H80	000
072A-3	1000	72	100	63600	500	ABB	OFAF000H100	000
087A-3	1000	87	100	63600	500	ABB	OFAF000H100	000
105A-3	1300	105	125	103000	500	ABB	OFAF00H125	00
145A-3	1700	145	160	185000	500	ABB	OFAF00H160	00
U_N = 500 V								
02A1-5	17	2.1	4	53	500	ABB	OFAF000H4	000
03A0-5	40	3.0	6	110	500	ABB	OFAF000H6	000
03A4-5	40	3.4	6	110	500	ABB	OFAF000H6	000
04A8-5	80	4.8	10	355	500	ABB	OFAF000H10	000
05A2-5	80	5.2	10	355	500	ABB	OFAF000H10	000

gG fuses (one fuse per phase)								
Drive type ACS880-01…	**Min. short-circuit current[1)]**	**Input current**	**Fuse**					
	A	A	A	A^2s	V	Manufacturer	Type	IEC size
07A6-5	120	7.6	16	700	500	ABB	OFAF000H16	000
11A0-5	120	11.0	16	700	500	ABB	OFAF000H16	000
014A-5	200	14	25	2500	500	ABB	OFAF000H25	000
021A-5	250	21	32	4500	500	ABB	OFAF000H32	000
027A-5	350	27	40	7700	500	ABB	OFAF000H40	000
034A-5	400	34	50	15400	500	ABB	OFAF000H50	000
040A-5	500	40	63	21300	500	ABB	OFAF000H63	000
052A-5	800	52	80	37000	500	ABB	OFAF000H80	000
065A-5	1000	65	100	63600	500	ABB	OFAF000H100	000
077A-5	1000	77	100	63600	500	ABB	OFAF000H100	000
096A-5	1300	96	125	103000	500	ABB	OFAF00H125	00
124A-5	1700	124	160	185000	500	ABB	OFAF00H160	00
U_N = 525…690 V								
07A3-7	115	7.3	16	1200	690	ABB	OFAA000GG16	000
09A8-7	145	9.8	20	2400	690	ABB	OFAA000GG20	000
14A2-7	190	14.2	25	4000	690	ABB	OFAA000GG25	000
018A-7	280	18	35	12000	690	ABB	OFAA000GG35	000
022A-7	450	22	50	24000	690	ABB	OFAA000GG50	000
026A-7	450	26	50	24000	690	ABB	OFAA000GG50	000
035A-7	520	35	63	30000	690	ABB	OFAA000GG63	000
042A-7	800	42	80	51000	690	ABB	OFAA0GG80	0
049A-7	800	49	80	51000	690	ABB	OFAA0GG80	0
061A-7	1050	61	100	95000	690	ABB	OFAA0GG100	0
084A-7	1700	84	160	240000	690	ABB	OFAA1GG160	1

Quick guide for selecting between gG and aR fuses

The combinations (cable size, cable length, transformer size and fuse type) in this table fulfil the minimum requirements for the proper operation of the fuse. Use this table to select between gG and aR fuses or calculate the short-circuit current of the installation as described under *Calculating the short-circuit current of the installation* on page *146*).

Drive type ACS880-01…	Cable type		Supply transformer minimum apparent power S_N (kVA)					
	Copper	Aluminium	Maximum cable legth with gG fuses			Maximum cable legth with aR fuses		
	mm^2	mm^2	10 m	50 m	100 m	10 m	100 m	200 m
Three-phase supply voltage 208V, 220V, **230V** or 240V								
04A6-2	3×1.5	-	1..1	1.1	-	0.8	0.9	-
06A6-2	3×1.5	-	2.2	2.4	-	0.8	0.9	-
07A5-2	3×1.5	-	3.3	4.3	-	0.8	0.9	-
10A6-2	3×1.5	-	3.3	4.3	-	1.5	1.8	-
16A8-2	3×6	-	5.5	5.8	-	1.8	1.8	-
24A3-2	3×6	-	9.7	11	-	3.3	3.5	-
031A-2	3×10	-	11	12	-	4.4	4.6	-
U_N = 380…415 V								
02A4-3	3×1.5	-	0.82	0.82	0.82	3.1	3.4	5.0
03A3-3	3×1.5	-	1.9	1.9	2.0	3.1	3.4	5.0
04A0-3	3×1.5	-	1.9	1.9	2.0	3.1	3.4	5.0
05A6-3	3×1.5	-	3.8	4.0	4.4	3.1	3.4	5.0
07A2-3	3×1.5	-	3.8	4.0	4.4	3.1	3.4	5.0
09A4-3	3×1.5	-	5.8	6.2	8.4	3.1	3.4	5.0
12A6-3	3×1.5	-	5.8	6.2	8.4	3.1	3.4	5.0
017A-3	3×6	-	9.6	9.8	10	5.8	5.9	6.2
025A-3	3×6	-	12	12	13	5.8	5.9	6.2
032A-3	3×10	-	17	17	18	8.2	8.3	8.7
038A-3	3×10	-	19	20	21	8.2	8.3	8.7
045A-3	3×16	3×25	24	24	26	13	14	15
061A-3	3×25	3×25	39	39	42	18	19	20
072A-3	3×35	3×35	48	49	52	23	24	25
087A-3	3×35	3×50	48	49	52	23	24	25
105A-3	3×50	3×70	63	65	68	34	35	37
145A-3	3×95	3×95	82	85	88	34	35	36
U_N = 500 V								
02A1-5	3×1.5	-	1.0	1.0	1.0	3.9	4.1	5.0
03A0-5	3×1.5	-	2.4	2.4	2.4	3.9	4.1	5.0
03A4-5	3×1.5	-	2.4	2.4	2.4	3.9	4.1	5.0
04A8-5	3×1.5	-	4.8	4.9	5.2	3.9	4.1	5.0

Drive type ACS880-01…	**Cable type**		**Supply transformer minimum apparent power S_N (kVA)**					
	Copper	**Aluminium**	**Maximum cable legth with gG fuses**			**Maximum cable legth with aR fuses**		
	mm^2	mm^2	10 m	50 m	100 m	10 m	100 m	200 m
05A2-5	3×1.5	-	4.8	4.9	5.2	3.9	4.1	5.0
07A6-5	3×1.5	-	7.2	7.5	8.9	3.9	4.1	5.0
11A0-5	3×1.5	-	7.2	7.5	8.9	3.9	4.1	5.0
014A-5	3×6	-	12	12	12	7.2	7.3	7.6
021A-5	3×6	-	15	15	16	7.2	7.3	7.6
027A-5	3×10	-	21	21	22	10	10	11
034A-5	3×10	-	24	24	25	10	10	11
040A-5	3×16	3×35	30	30	31	17	17	18
052A-5	3×25	3×35	48	49	51	18	18	19
065A-5	3×35	3×50	60	61	63	29	29	30
077A-5	3×35	3×70	60	61	63	29	29	30
096A-5	3×50	3×70	78	80	83	42	43	45
124A-5	3×95	3×120	103	105	108	42	43	44
U_N = 525…690 V								
07A3-7	3×1.5	-	9.5	9.7	10.4	3.3	3.3	3.5
09A8-7	3×1.5	-	12	12	14	4.4	4.5	4.7
14A2-7	3×2.5	-	16	16	17	7.8	8.0	8.6
018A-7	3×4	-	23	24	25	9.9	10	11
022A-7	3×6	-	37	38	41	13	13	14
026A-7	3×10	3×25	37	38	39	13	13	14
035A-7	3×10	3×25	43	44	45	14	14	14
042A-7	3×16	3×25	66	67	70	23	23	24
049A-7	3×16	3×25	66	67	70	23	23	24
061A-7	3×25	3×35	87	89	91	40	40	42
084A-7	3×35	3×50	141	145	152	58	59	61

Calculating the short-circuit current of the installation

Check that the short-circuit current of the installation is at least the value given in the fuse table.

The short-circuit current ot the installation can be calculated as follows:

$$I_{k2\text{-}ph} = \frac{U}{2 \cdot \sqrt{R_c^2 + (Z_k + X_c)^2}}$$

where

$I_{k2\text{-}ph}$ = short-circuit current in symmetrical two-phase short-circuit

U = network line-to-line voltage (V)

R_c = cable resistance (ohm)

$Z_k = z_k \cdot U_N^2/S_N$ = transformer impedance (ohm)

z_k = transformer impedance (%)

U_N = transformer rated voltage (V)

S_N = nominal apparent power of the transformer (kVA)

X_c = cable reactance (ohm).

Calculation example

Drive:

- ACS880-01-145A-3
- supply voltage = 410 V

Transformer:

- rated power S_N = 600 kVA
- rated voltage (drive supply voltage) U_N = 430 V
- transformer impedance z_k = 7.2%.

Supply cable:

- length = 170 m
- resistance/length = 0.398 ohm/km
- reactance/length = 0.082 ohm/km.

$$Z_k = z_k \cdot \frac{U_N^2}{S_N} = 0.072 \cdot \frac{(430\ \text{V})^2}{600\ \text{kVA}} = 22.19\ \text{mohm}$$

$$R_c = 170\ \text{m} \cdot 0.398\ \frac{\text{ohm}}{\text{km}} = 67.66\ \text{mohm}$$

$$X_c = 170\ \text{m} \cdot 0.082\ \frac{\text{ohm}}{\text{km}} = 13.94\ \text{mohm}$$

$$I_{k2\text{-}ph} = \frac{410\ \text{V}}{2 \cdot \sqrt{(67.66\ \text{mohm})^2 + (22.19\ \text{mohm} + 13.94\ \text{mohm})^2}} = 2.7\ \text{kA}$$

The calculated short-circuit current 2.7 kA is higher than the minimum short-circuit current of the drive gG fuse type OFAF00H160 (1700 A). -> The 500 V gG fuse (ABB Control OFAF00H160) can be used.

Fuses (UL)

UL class T fuses for branch circuit protection per NEC are listed below. Fast acting class T or faster fuses are recommended in the USA. **Check on the fuse time-current curve to ensure the operating time of the fuse is below 0.5 seconds for units of frame sizes R1 to R6 and below 0.1 seconds for units of frame sizes R7 to R9. Follow local regulations.**

Note 1: See also *Implementing thermal overload and short-circuit protection* on page *69*.

Note 2: Fuses with higher current rating than the recommended ones must not be used.

Note 3: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

Drive type ACS880-01…	Input current	Fuse (one fuse per phase)				
	A	A	V	Manufacturer	Type	UL class
U_N = 208…240 V						
04A6-2	4.6	15	600	Bussmann	JJS-15	T
06A6-2	6.6	15	600	Bussmann	JJS-15	T
07A5-2	7.5	15	600	Bussmann	JJS-15	T
10A6-2	10.6	20	600	Bussmann	JJS-20	T
16A8-2	16.8	25	600	Bussmann	JJS-25	T
24A3-2	24.3	40	600	Bussmann	JJS-40	T
031A-2	31.0	50	600	Bussmann	JJS-50	T
U_N = 440…480 V						
02A1-5	2.1	3	600	Bussmann	JJS-3	T
03A0-5	3.0	6	600	Bussmann	JJS-6	T
03A4-5	3.4	6	600	Bussmann	JJS-6	T
04A8-5	4.8	10	600	Bussmann	JJS-10	T
05A2-5	5.2	10	600	Bussmann	JJS-10	T
07A6-5	7.6	15	600	Bussmann	JJS-15	T
11A0-5	11	20	600	Bussmann	JJS-20	T
014A-5	14	25	600	Bussmann	JJS-25	T
021A-5	21	35	600	Bussmann	JJS-35	T
027A-5	27	40	600	Bussmann	JJS-40	T
034A-5	34	50	600	Bussmann	JJS-50	T
040A-5	40	60	600	Bussmann	JJS-60	T
052A-5	52	80	600	Bussmann	JJS-80	T
065A-5	65	90	600	Bussmann	JJS-90	T
077A-5	77	110	600	Bussmann	JJS-110	T
096A-5	96	150	600	Bussmann	JJS-150	T
124A-5	124	200	600	Bussmann	JJS-200	T
156A-5	156	225	600	Bussmann	JJS-225	T
180A-5	180	300	600	Bussmann	JJS-300	T
240A-5	240	350	600	Bussmann	JJS-350	T
260A-5	260	400	600	Bussmann	JJS-400	T
302A-5	302	400	600	Bussmann	JJS-400	T
361A-5	361	500	600	Bussmann	JJS-500	T
414A-5	414	600	600	Bussmann	JJS-600	T

Dimensions. weights and free space requirements

Frame	IP21					UL type 1				
	H1	H2	W	D	Weight	H1	H2	W	D	Weight
	mm	mm	mm	mm	kg	in.	in.	in.	in.	lb
R1	405	370	155	226	6	15.94	14.57	6.10	8.89	13
R2	405	370	155	249	8	15.94	14.57	6.10	9.80	18
R3	471	420	172	261	10	18.54	16.54	6.77	10.28	22
R4	576	490	203	274	18.5	22.70	19.30	7.99	10.80	41
R5	730	596	203	274	23	28.74	23.46	7.99	10.79	51
R6	726	569	251	357	45	28.60	22.40	9.92	14.09	99
R7	880	600	284	365	55	34.70	23.60	11.22	14.37	121
R8	963	681	300	386	70	37.90	26.82	11.81	15.21	154
R9	955	680	380	413	98	37.59	26.77	14.96	16.27	216
Frame	**IP55**					**UL type 12**				
	H1	**H2**	**W**	**D**	**Weight**	**H1**	**H2**	**W**	**D**	**Weight**
	mm	mm	mm	mm	kg	in.	in.	in.	in.	lb
R1	450	-	162	292	6	17.72	-	6.38	11.50	13
R2	450	-	161	315	8	17.72	-	6.38	12.40	18
R3	525	-	180	327	10	20.70	-	7.09	12.87	22
R4	576	-	203	344	18.5	22.70	-	7.99	13.54	41
R5	730	-	203	344	23	28.73	-	7.99	13.54	51
R6	726	-	252	421	45	28.60	-	9.92	16.46	99
R7	880	-	284	423	55	34.66	-	11.18	16.65	121

H1 Height with cable entry box

H2 Height without cable entry box

W Width with cable entry box

D Depth with cable entry box

Note: For more information on dimensions, see chapter *Dimension drawings*.

200 mm (7.87 in.) free space is required at top of the drive.

300 mm (11.81 in.) free space (when measured from the drive base without the cable entry box) is required at bottom of the drive.

Losses, cooling data and noise

Drive type ACS880-01-	Frame	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB(A)
U_N = 208…240 V					
04A6-2	R1	44	26	73	46
06A6-2	R1	44	26	94	46
07A5-2	R1	44	26	122	46
10A6-2	R1	44	26	172	46
16A8-2	R2	88	52	232	51
24A3-2	R2	88	52	337	51
031A-2	R3	134	79	457	57
U_N = 380…415 V					
02A4-3	R1	44	26	30	46
03A3-3	R1	44	26	40	46
04A0-3	R1	44	26	52	46
05A6-3	R1	44	26	73	46
07A2-3	R1	44	26	94	46
09A4-3	R1	44	26	122	46
12A6-3	R1	44	26	172	46
017A-3	R2	88	52	232	51
025A-3	R2	88	52	337	51
032A-3	R3	134	79	457	57
038A-3	R3	134	79	562	57
045A-3	R4	134	79	667	62
061A-3	R4	280	165	907	62
072A-3	R5	280	165	1117	62
087A-3	R5	280	165	1120	62
105A-3	R6	435	256	1295	67
145A-3	R6	435	256	1440	67
169A-3	R7	450	265	1940	67
206A-3	R7	450	265	2310	67
246A-3	R8	550	324	3300	65
293A-3	R8	550	324	3900	65
363A-3	R9	1150	677	4800	68
430A-3	R9	1150	677	6000	68

Drive type ACS880-01-	Frame	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB(A)
U_N = 440…500 V					
02A1-5	R1.	44	26	30	46
03A0-5	R1	44	26	40	46
03A4-5	R1	44	26	52	46
04A8-5	R1	44	26	73	46
05A2-5	R1	44	26	94	46
07A6-5	R1	44	26	122	46
11A0-5	R1	44	26	172	46
014A-5	R2	88	52	232	51
021A-5	R2	88	52	337	51
027A-5	R3	134	79	457	57
034A-5	R3	134	79	562	57
040A-5	R4	134	79	667	62
052A-5	R4	280	165	907	62
065A-5	R5	280	165	1117	62
077A-5	R5	280	165	1120	62
096A-5	R6	435	256	1295	67
124A-5	R6	435	256	1440	67
156A-5	R7	450	265	1940	67
180A-5	R7	450	265	2310	67
240A-5	R8	550	324	3300	65
260A-5	R8	550	324	3900	65
302A-5	R9	1150	677	4200	68
361A-5	R9	1150	677	4800	68
414A-5	R9	1150	677	6000	68

Drive type ACS880-01-	Frame	Air flow		Heat dissipation	Noise
		m^3/h	ft^3/min	W	dB(A)
U_N = 525…690 V					
07A3-7	R5	280	165	217	62
09A8-7	R5	280	165	284	62
14A2-7	R5	280	165	399	62
018A-7	R5	280	165	490	62
022A-7	R5	280	165	578	62
026A-7	R5	280	165	660	62
035A-7	R5	280	165	864	62
042A-7	R5	280	165	998	62
049A-7	R5	280	165	1120	62
061A-7	R6	435	256	1295	67
084A-7	R6	435	256	1440	67
098A-7	R7	450	265	1940	67
119A-7	R7	450	265	2310	67
142A-7	R8	550	324	3300	65
174A-7	R8	550	324	3900	65
210A-7	R9	1150	677	4200	68
271A-7	R9	1150	677	4800	68

Terminal and lead-through data for the power cables

IEC

Input, motor, resistor and DC cable terminal screw sizes, accepted wire sizes (per phase) and tightening torques (*T*) are given below. *l* denotes stripping length inside the terminal.

Frame	Cable lead-throughs		L1, L2, L3, T1/U, T2/V, T3/W						Grounding terminals	
	Per phase	Ø *	Wire size	*T* (Wire screw)		*l*	*T* (Terminal nut)		Wire size	*T*
	pcs	mm	mm^2	M…	N·m	mm	M...	N·m	mm^2	N·m
R1	1	17	0.75…6	-	0.6	8	-	-	16	1.8
R2	1	17	0.75…6	-	0.6	8	-	-	16	1.8
R3	1	21	0.5…16	-	1.7	10	-	-	16	1.8
R4	1	24	0.5…35	-	3.3	18	-	-	16	2.9
R5	1	32	6…70	M6	15	18	M6	6	35	2.9
R6	1	43	25…150	M10	30	30	M8	24	185	9.8
R7	1	54	95…240 (25…150**)	M10	40 (30**)	30	M8	24	185	9.8
R8	2	43	2 × (50…150)	M10	40	30	M10	24	2×185	9.8
R9	2	54	2 × (95…240)	M12	70	30	M10	24	2×185	9.8

Frame	Cable lead-throughs		R-, R+/UDC+ and UDC- terminals					
		Ø *	Wire size	*T* (Wire screw)		*l*	*T* (Terminal nut ()	
	pcs	mm	mm^2	M…	N·m	mm	M…	N·m
R1	1	17	0.75…6	-	0.6	8	-	-
R2	1	17	0.75…6	-	0.6	8	-	-
R3	1	21	0.5…16	-	1.7	10	-	-
R4	1	24	0.5…35	M6	15	18	M6	6
R5	1	32	6…70	M10	30	30	M8	24
R6	1	37	25…95	M8	20	30	M8	20
R7	1	43	25…150	M10	30	30	M10	30
R8	1	43	2 × (50…150)	M10	40	30	M8	24
R9	1	54	2 × (95…240)	M12	70	30	M8	24

* maximum cable diameter accepted. For the lead-through plate hole diameters, see chapter *Dimension drawings*.

** 525…690 V drives

US

Input, motor, resistor and DC cable terminal screw sizes, accepted wire sizes (per phase) and tightening torques (*T*) in US units are given below. *l* denotes stripping length inside the terminal.

Frame	Cable lead-throughs		L1, L2, L3, T1/U, T2/V, T3/W						Grounding terminals	
	Per phase	Ø *	Wire size	*T* (Wire screw)		*l*	*T* (Terminal nut)		Wire size	
	pcs	in.	kcmil/AWG	M…	lbf·ft	in.	M…		AWG	lbf·ft
R1	1	0.67	18…10	-	0.4	0.31	-	-	5	1.3
R2	1	0.67	18…10	-	0.4	0.31	-	-	5	1.3
R3	1	0.83	20…6	-	1.3	0.39	-	-	5	1.3
R4	1	0.94	20…2	-	2.4	0.70	-	-	6	2.1
R5	1	1.26	4…1/0	M6	11.0	0.70	M6	4.4	2	2.1
R6	1	1.69	3…300 MCM	M10	22.1	1.18	M8	17.7	350 MCM	7.2
R7	1	2.13	4/0…400 MCM (3…300 MCM**)	M10	29.5 (22.1**)	1.18	M8	17.7	350 MCM	7.2
R8	2	1.69	2 × (300…400 MCM)	M10	29.5	1.18	M10	17.7	2× 350 MCM	7.2
R9	2	2.13	2 × (4/0…400 MCM)	M12	51.6	1.18	M10	17.7	2× 350 MCM	7.2

Frame	Cable lead-throughs		R-, R+/UDC+ and UDC- terminals					
		Ø *	Wire size	Screw (wire)		*l*	Nut (terminal)	
	pcs	in.	kcmil/AWG	M…	lbf·ft	mm	M…	lbf·ft
R1	1	0.67	18…10	-	0.4	0.31	-	-
R2	1	0..67	18…10	-	0.4	0.31	-	-
R3	1	0.83	20…6	-	1.3	0.39	-	-
R4	1	0.94	20…2	M6	11.0	0.70	M6	4.4
R5	1	1.26	4…1/0	M10	22.1	1.18	M8	17.7
R6	1	1.46	3/0	M8	14.8	1.18	M8	14.8
R7	1	1.69	300 MCM	M10	29.5	1.18	M10	29.5
R8	1	1.69	2 × (300…400 MCM)	M10	29.5	1.18	M8	17.7
R9	1	2.13	2 × (4/0…400 MCM)	M12	51.6	1.18	M8	17.7

* maximum cable diameter accepted. Cable connector inside diameter: 3/4” (frames R1 and R2), 1” (R3). For the lead-through plate hole diameters, see chapter *Dimension drawings*.

** 525…690 V drives

UL listed cable lugs and tools

Wire size	**Compression lug**		**Crimping tool**		
kcmil/AWG	Manufacturer	Type	Manufacturer	Type	No. of crimps
6	Thomas & Betts	E10731 54136	Thomas & Betts	TBM4S TBM45S	1
	Burndy	YAV6C-L2	Burndy	MY29-3	1
	Ilsco	CCL-6-38	Ilsco	ILC-10	2
4	Thomas & Betts	54140	Thomas & Betts	TBM4S	1
	Burndy	YA4C-L4BOX	Burndy	MY29-3	1
	Ilsco	CCL-4-38	Ilsco	MT-25	1
2	Thomas & Betts	54143TB 54142TB	Thomas & Betts	TBM4S TBM4S	1
	Burndy	YA2C-L4BOX	Burndy	MY29-3	2
	Ilsco	CRC-2	Ilsco	IDT-12	1
	Ilsco	CCL-2-38	Ilsco	MT-25	1
1	Thomas & Betts	54148	Thomas & Betts	TBM-8	3
	Burndy	YA1C-L4BOX	Burndy	MY29-3	2
	Ilsco	CRA-1-38	Ilsco	IDT-12	1
	Ilsco	CCL-1-38	Ilsco	MT-25	1
1/0	Thomas & Betts	54109	Thomas & Betts	TBM-8	3
	Burndy	YA25-L4BOX	Burndy	MY29-3	2
	Ilsco	CRB-0	Ilsco	IDT-12	1
	Ilsco	CCL-1/0-38	Ilsco	MT-25	1
2/0	Thomas & Betts	54110	Thomas & Betts	TBM-8	3
	Burndy	YAL26T38	Burndy	MY29-3	2
	Ilsco	CRA-2/0	Ilsco	IDT-12	1
	Ilsco	CCL-2/0-38	Ilsco	MT-25	1

Terminal data for the control cables

See *Control unit/board (ZCU-11/ZCON-11) connection data* below.

Electrical power network specification

Voltage (U_1)	ACS880-01-xxxx-2 units: 208 … 240 V AC 3-phase +10%…-15% ACS880-01-xxxx-3 units: 380 … 415 V AC 3-phase +10%…-15% ACS880-01-xxxx-5 units: 380 … 500 V AC 3-phase +10%…-15% ACS880-01-xxxx-7 units: 525 … 690 V AC 3-phase +10%…-15%
Network type	TN (grounded) and IT (ungrounded) systems.
Rated conditional short-circuit current (IEC 61439-1)	65 kA when protected by fuses given in the fuse tables
Short-circuit current protection (UL 508C, CSA C22.2 No. 14-05)	US and Canada: The drive is suitable for use on a circuit capable of delivering not more than 100 kA symmetrical amperes (rms) at 600 V maximum when protected by fuses given in the fuse table
Frequency	47 to 63 Hz, maximum rate of change 17%/s
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos phi$_1$)	0.98 (at nominal load)

Motor connection data

Motor types	Asynchronous AC induction motors, permanent magnet synchronous motors and AC induction servomotors
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Frequency	0…500 Hz
Current	See section *Ratings*.
Switching frequency	2.7 kHz (typically)
Maximum recommended motor cable length	For ACS880-01-xxxx-2, ACS880-01-xxxx-3 and ACS880-01-xxxx-5 frames R1 to R3 and for types ACS880-01-07A3-7, ACS880-01-09A8-7, ACS880-01-14A2-7 and ACS880-01-018A-7: 150 m (492 ft) For ACS880-01-xxxx-2, ACS880-01-xxxx-3 and ACS880-01-xxxx-5 frames R4 to R9 and for types from ACS880-01-022A-7 to ACS880-01-271A-7: 300 m (984 ft). **Note:** With motor cables longer than 150 m (492 ft) the EMC Directive requirements may not be fulfilled.

Control unit/board (ZCU-11/ZCON-11) connection data

Power supply (XPOW)

24 V (±10%) DC, 2 A
Supplied from the power unit of the drive, or from an external power supply through connector XPOW (pitch 5 mm, wire size 2.5 mm^2).

Relay outputs RO1…RO3 (XRO1 … XRO3)

Connector pitch 5 mm, wire size 2.5 mm^2
250 V AC / 30 V DC, 2 A
Protected by varistors

+24 V output (XD24:2 and XD24:4)

Connector pitch 5 mm, wire size 2.5 mm^2
Total load capacity of these outputs is 4.8 W (200 mA / 24 V) minus the power taken by DIO1 and DIO2.

Digital inputs DI1…DI6 (XDI:1 … XDI:6)

Connector pitch 5 mm, wire size 2.5 mm^2
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP (DI1…DI5), NPN (DI6)
Hardware filtering: 0.04 ms, digital filtering up to 8 ms
DI6 (XDI:6) can alternatively be used as an input for 1…3 PTC thermistors.
“0” > 4 kohm, “1” < 1.5 kohm
I_{max}: 15 mA (for DI6 5 mA)

Start interlock input DIIL (XD24:1)

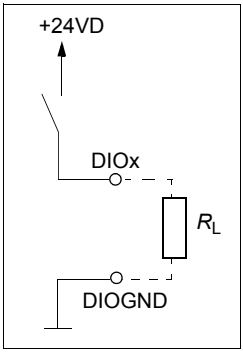
Connector pitch 5 mm, wire size 2.5 mm^2
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Input type: NPN/PNP
Hardware filtering: 0.04 ms, digital filtering up to 8 ms

Digital inputs/outputs DIO1 and DIO2 (XDIO:1 and XDIO:2)

Input/output mode selection by parameters.

DIO1 can be configured as a frequency input (0…16 kHz with hardware filtering of 4 microseconds) for 24 V level square wave signal (sinusoidal or other wave form cannot be used). DIO2 can be configured as a 24 V level square wave frequency output. See the firmware manual, parameter group 11.

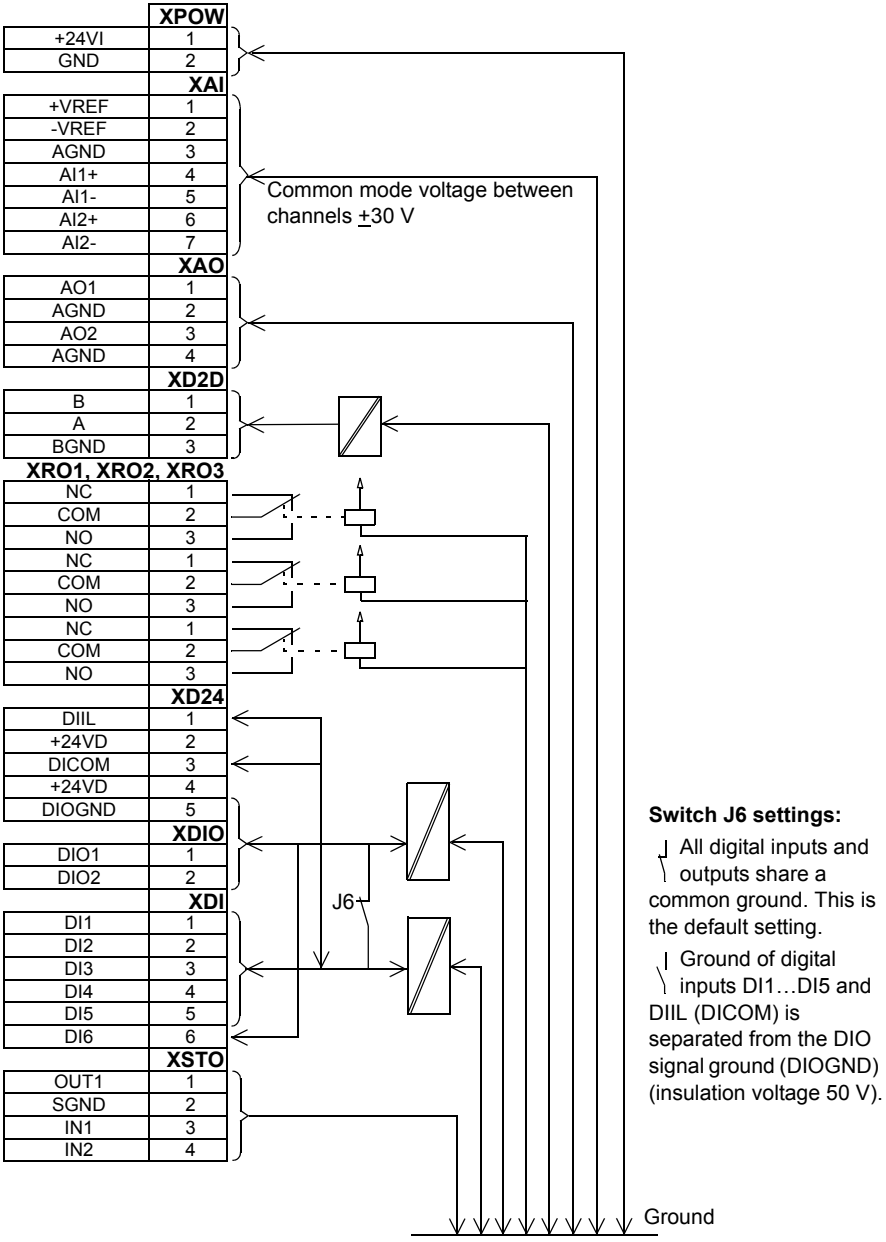
Connector pitch 5 mm, wire size 2.5 mm^2
As inputs:
24 V logic levels: “0” < 5 V, “1” > 15 V
R_{in}: 2.0 kohm
Filtering: 0.25 ms
As outputs:
Total output current from +24VD is limited to 200 mA.



Reference voltage for analog inputs +VREF and -VREF (XAI:1 and XAI:2)	Connector pitch 5 mm, wire size 2.5 mm^2 10 V ±1% and –10 V ±1%, R_{load} 1…10 kohm
Analog inputs AI1 and AI2 (XAI:4 … XAI:7). Current/voltage input mode selection by jumpers. See page 100.	Connector pitch 5 mm, wire size 2.5 mm^2 Current input: –20…20 mA, $R_{in:}$ 100 ohm Voltage input: –10…10 V, R_{in}: 200 kohm Differential inputs, common mode range ±30 V Sampling interval per channel: 0.25 ms Hardware filtering: 0.25 ms, adjustable digital filtering up to 8 ms Resolution: 11 bit + sign bit Inaccuracy: 1% of full scale range
Analog outputs AO1 and AO2 (XAO)	Connector pitch 5 mm, wire size 2.5 mm^2 0…20 mA, R_{load} < 500 ohm Frequency range: 0…300 Hz Resolution: 11 bit + sign bit Inaccuracy: 2% of full scale range
Drive to drive link (XD2D)	Connector pitch 5 mm, wire size 2.5 mm^2 Physical layer: RS-485 Termination by switch
Safe torque off connection (XSTO)	Connector pitch 5 mm, wire size 2.5 mm^2 Current consumption per channel: 55 mA (continuous) For the drive to start, both connections must be closed (OUT1 to IN1 and IN2).
Control panel / PC connection	Connector: RJ-45 Cable length < 3 m

The terminals on the board fulfil the Protective Extra Low Voltage (PELV) requirements. The PELV requirements of a relay output are not fulfilled if a voltage higher than 48 V is connected to the relay output.

Ground isolation diagram



Switch J6 settings:

All digital inputs and outputs share a common ground. This is the default setting.

Ground of digital inputs DI1…DI5 and DIIL (DICOM) is separated from the DIO signal ground (DIOGND) (insulation voltage 50 V).

Efficiency

Approximately 98% at nominal power level

Degree of protection

IP21 (UL Type 1), IP55 (UL Type 12)

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	1. 0 to 4000 m (13123 ft) above sea level 2. 0 to 2000 m (6561 ft) above sea level Above 1000 m [3281 ft]), see page *138*.	-	-
	1. TN and TT neutral-grounded network systems and IT non-corner grounded network systems 2. TN, TT and IT corner-grounded network systems		
Air temperature	-15 to +55 °C (5 to 131 °F). No frost allowed. See section *Ratings*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	Chemical gases: Class 3C2 Solid particles: Class 3S2	Chemical gases: Class 1C2 Solid particles: Class 1S3	Chemical gases: Class 2C2 Solid particles: Class 2S2
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres

Vibration (IEC 60068-2)	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s^2 (23 ft/s^2) (13.2 to 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s^2 (49 ft/s^2) (9 to 200 Hz) sinusoidal
Shock (IEC 60068-2-27)	Not allowed	Max. 100 m/s^2 (330 ft./s^2), 11 ms	Max. 100 m/s^2 (330 ft./s^2), 11 ms
Free fall	Not allowed	100 mm (4 in.) for weight over 100 kg (220 lb)	100 mm (4 in.) for weight over 100 kg (220 lb)

Materials

Drive enclosure

- PC/ABS 3 mm, color NCS 1502-Y (RAL 9002 / PMS 1C Cool Grey) and RAL 9017
- PC+10%GF 3.0mm, Color RAL 9017 (in frames R1 to R3 only)
- hot-dip zinc coated steel sheet 1.5 to 2.5 mm, thickness of coating 100 micrometers, color NCS 1502-Y

Package

Plywood and cardboard. Foam cushions PP-E, bands PP.

Disposal

The main parts of the drive can be recycled to preserve natural resources and energy. Produt parts and materials should be dismantled and separated.

Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropprate identification code.

Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.

EN 60204-1:2006 + A1 2009

Safety of machinery. Electrical equipment of machines. Part 1: General requirements. Provisions for compliance:
The final assembler of the machine is responsible for installing
- emergency-stop device
- supply disconnecting device.

IEC/EN 60529:1992	*Degrees of protection provided by enclosures (IP code)*
IEC 60664-1:2007	*Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.*
EN 61800-3:2004	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
EN 61800-5-1:2007	*Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy*
EN 61800-5-2:2007	*Adjustable speed electrical power drive systems. Part 5-2: Safety requirements – Functional*
UL 508C:2002	*UL Standard for Safety, Power Conversion Equipment, second edition*
NEMA 250:2008	*Enclosures for Electrical Equipment (1000 Volts Maximum)*
CSA C22.2 No. 14-10	*Industrial control equipment*
GOST R 51321-1:2007	*Low-voltage switchgear and control gear assemblies. Part 1 - Requirements for type-tested and partially type-tested assemblies - General technical requirements and methods of tests*

CE marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC and RoHS Directives. The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standards EN 60204-1 and EN 61800-5-1.

Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section *Compliance with the EN 61800-3:2004* below.

Compliance with the European RoHS Directive

The RoHS Directive defines the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Compliance with the European Machinery Directive

The drive is an electronic product which is covered by the European Low Voltage Directive. However, the drive includes the Safe torque off function and can be equipped with other safety functions for machinery which, as safety components, are in the scope of the Machinery Directive. These functions of the drive comply with European harmonized standards such as EN 61800-5-2. The declaration of conformity is shown below.

Declaration of Conformity

Declaration of Conformity

(According to Machinery Directive 2006/42/EC)

Manufacturer: ABB Oy, Drives
Address: Hiomotie 13, P.O Box 184, FIN-00381 Helsinki, Finland.

hereby declares that product

ACS880-01

with regard to the following safety functions

Safe torque off

Safe stop 1 (with option code +Q973)

Safe stop emergency (with option code +Q973)

Safely-limited speed (with option code +Q973)

Safe maximum speed (with option code +Q973)

Safe brake control (with option code +Q973)

fulfil all the relevant safety component requirements of EC Machinery Directive 2006/42/EC, when the listed safety functions are used for safety component functionality.

The following harmonized standards below were used:

EN 61800-5-2: 2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements - Functional*
EN 62061: 2005/ AC: 2010	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1: 2008/ AC: 2009	*Safety of machinery – Safety-related parts of control systems. Part 1: General requirements*
EN ISO 13849-2: 2008	*Safety of machinery – Safety-related parts of the control systems. Part 2: Validation*
EN 60204-1: 2006/ AC: 2010	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

Other used standards:

IEC 61508 ed. 2: 2010	Functional safety of electrical / electronic / programmable electronic safety-related systems

The products referred in this Declaration of Conformity fulfil the relevant provisions of the Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC. Declaration of conformity according to these directives is available from the manufacturer.

3AXD1000099646 Page: 1(2)

Declaration of Conformity

(According to Machinery Directive 2006/42/EC)

Person authorized to compile the technical file:

Name: Risto Mynttinen
Address: P.O. Box 184, FIN-00381 Helsinki, Finland

Helsinki, 29 Nov 2012

Mika Kulju

Vice President
ABB Oy

Compliance with the EN 61800-3:2004

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not supplying domestic premises.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment. **Note:** A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

Drive of category C3: drive of rated voltage less than 1000 V and intended for use in the second environment and not intended for use in the first environment.

Drive of category C4: drive of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

Category C2

The drive complies with the standard with the following provisions:

1. The drive is equipped with EMC filter +E202.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 150 meters.

WARNING! The drive may cause radio interference if used in residential or domestic environment. The user is required to take measures to prevent interference, in association to the requirements for the CE compliance listed above, if necessary.

Note: Do not install a drive equipped with EMC filter +E202 on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage to the unit.

Category C3

The drive complies with the standard with the following provisions:

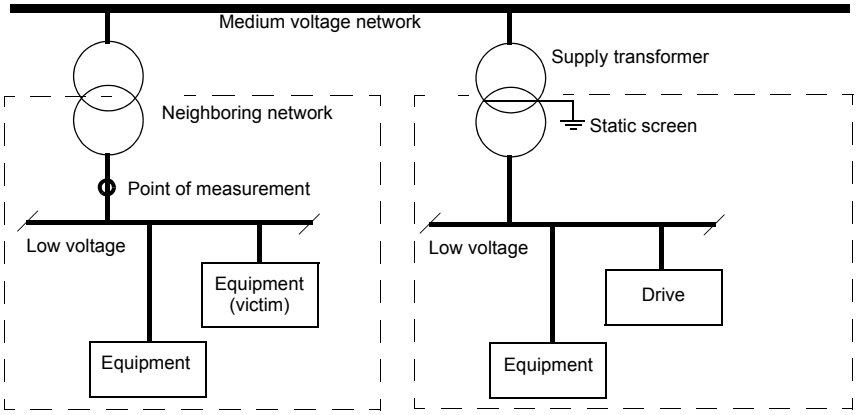
1. The drive is equipped with EMC filter +E200 or +E201.
2. The motor and control cables are selected as specified in the hardware manual.
3. The drive is installed according to the instructions given in the hardware manual.
4. Maximum motor cable length is 150 meters.

WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Category C4

If the provisions under *Category C3* cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The motor and control cables are selected as specified in the hardware manual.
4. The drive is installed according to the instructions given in the hardware manual.

WARNING! A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

UL marking

cULus Listed types:

- frames R1 to R9 of voltage range 380…500 V and degree of protection UL Type 1 (IP21)
- frames R1 to R3 of voltage range 208…240 V and degrees of protection UL Type 1 (IP21)

The listing is pending for the other types. The approval is valid with rated voltages.

UL checklist

- The drive is to be used in a heated, indoor controlled environment. The drive must be installed in clean air according to enclosure classification. Cooling air must be clean, free from corrosive materials and electrically conductive dust. See page *160*.
- The maximum ambient air temperature is 40 °C (104 °F) at rated current. The current is derated for 40 to 55 °C (104 to 131 °F).
- The drive is suitable for use in a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 V maximum. The ampere rating is based on tests done according to UL 508C.
- The cables located within the motor circuit must be rated for at least 75 °C (167 °F) in UL-compliant installations.
- The input cable must be protected with fuses. Circuit breakers must not be used without fuses in the USA. Suitable IEC (class aR) fuses are listed on page *139* and UL (class T) fuses on page *147*. For suitable circuit breakers, contact your local ABB representative.
- For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfill this requirement, use the UL classified fuses.
- For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes. To fulfill this requirement, use the UL classified fuses.
- The drive provides overload protection in accordance with the National Electrical Code (NEC).

CSA marking

The drives of frame sizes R1 to R3 are CSA marked. The CSA marking is pending for the other frames. The approval is valid with rated voltages.

“C-tick” marking

C-tick marking is pending for the drive.

“C-tick” marking is required in Australia and New Zealand. A “C-tick” mark is attached to the drive to verify compliance with the relevant standard (IEC 61800-3:2004), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

For fulfilling the requirements of the standard, see section *Compliance with the EN 61800-3:2004* on page *166*.

GOST R certificate of conformity

The drive has been given a GOST R certificate of conformity.

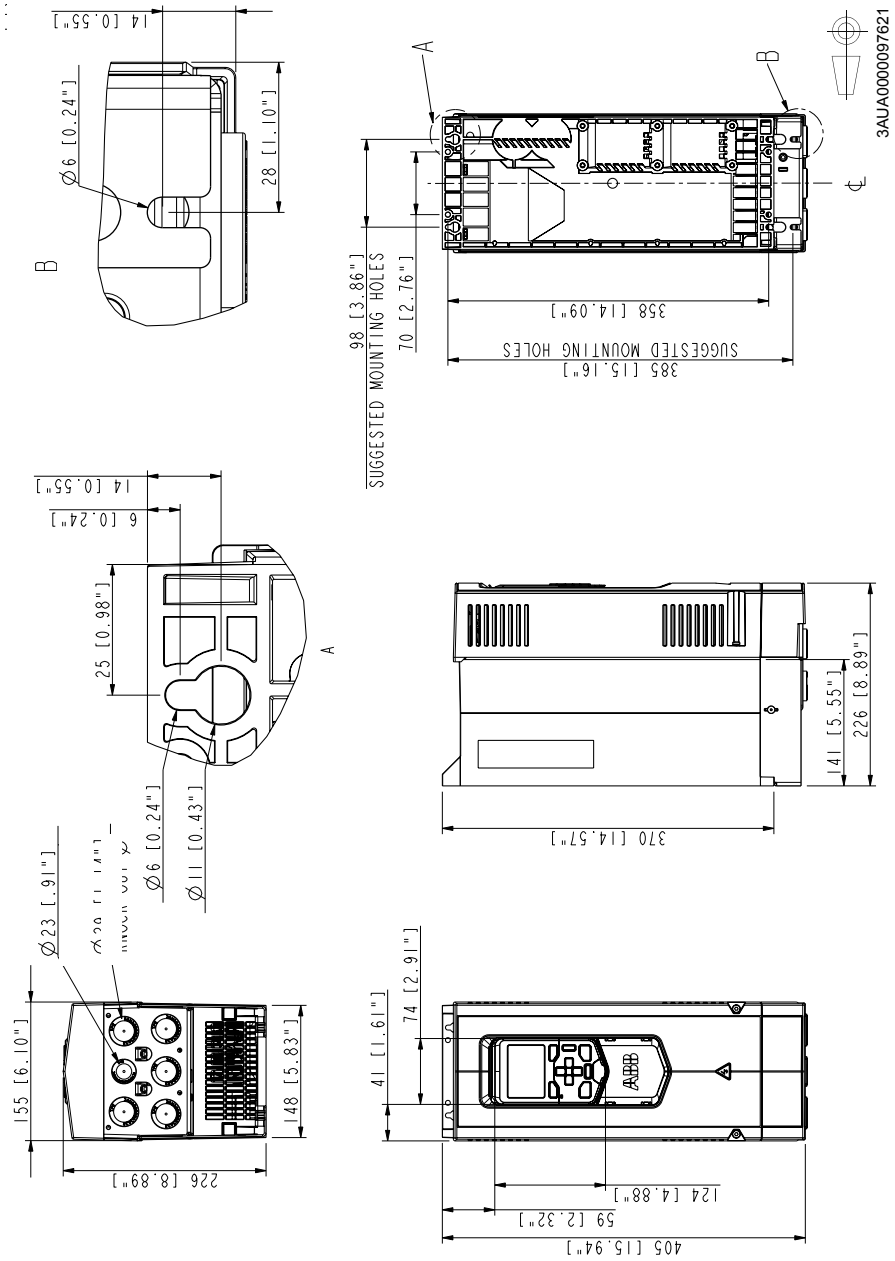
12

Dimension drawings

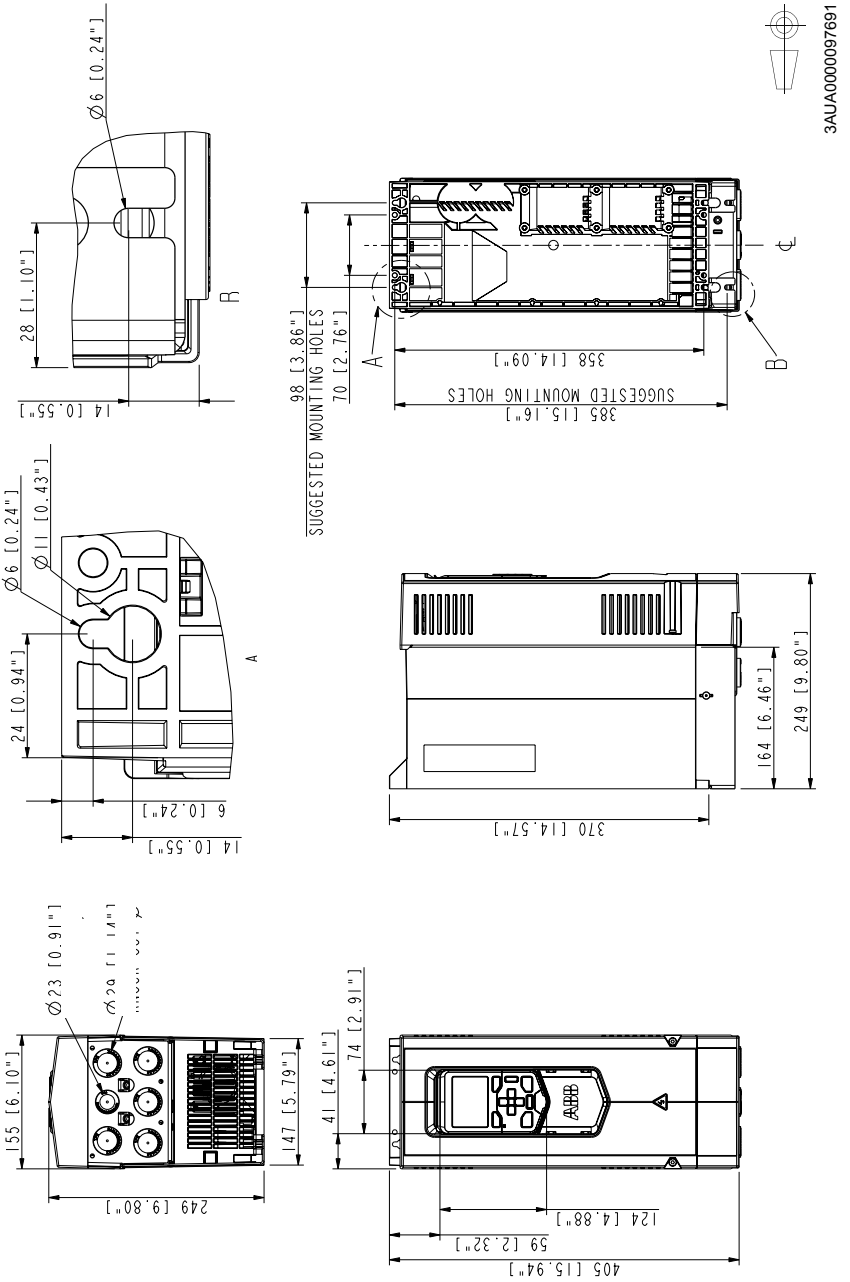
What this chapter contains

This chapter contains dimension drawings of the drive.

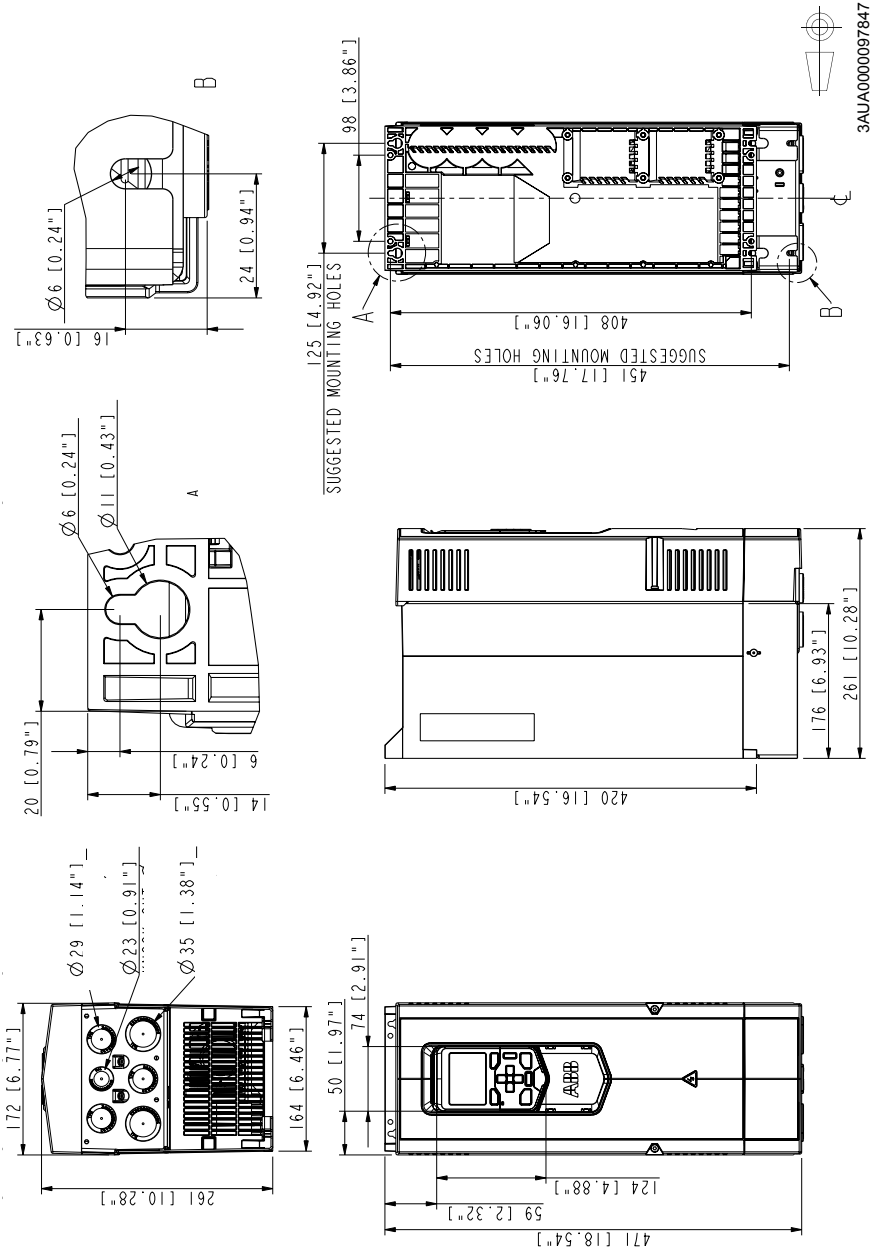
Frame R1 (IP21, UL Type 1)



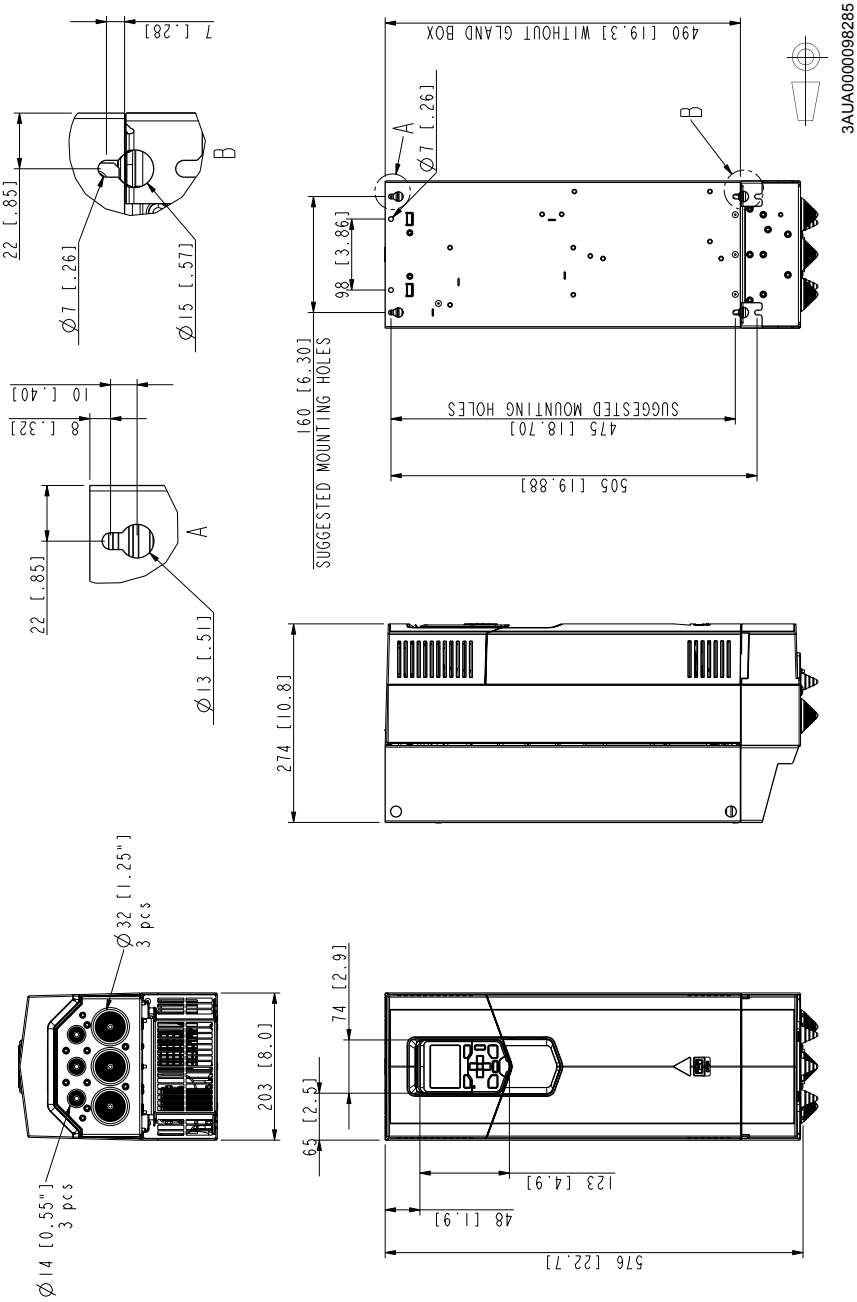
Frame R2 (IP21, UL Type 1)



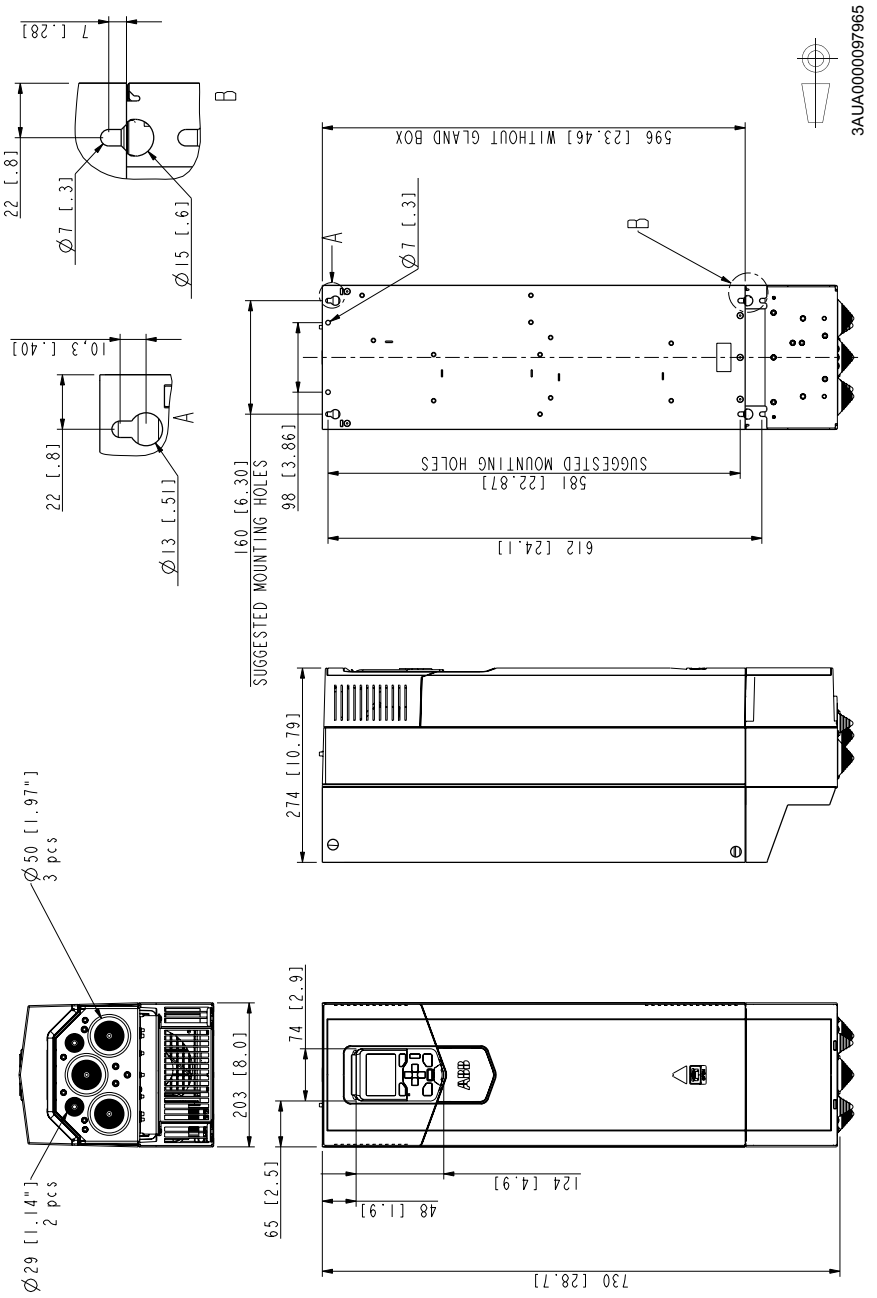
Frame R3 (IP21, UL Type 1)



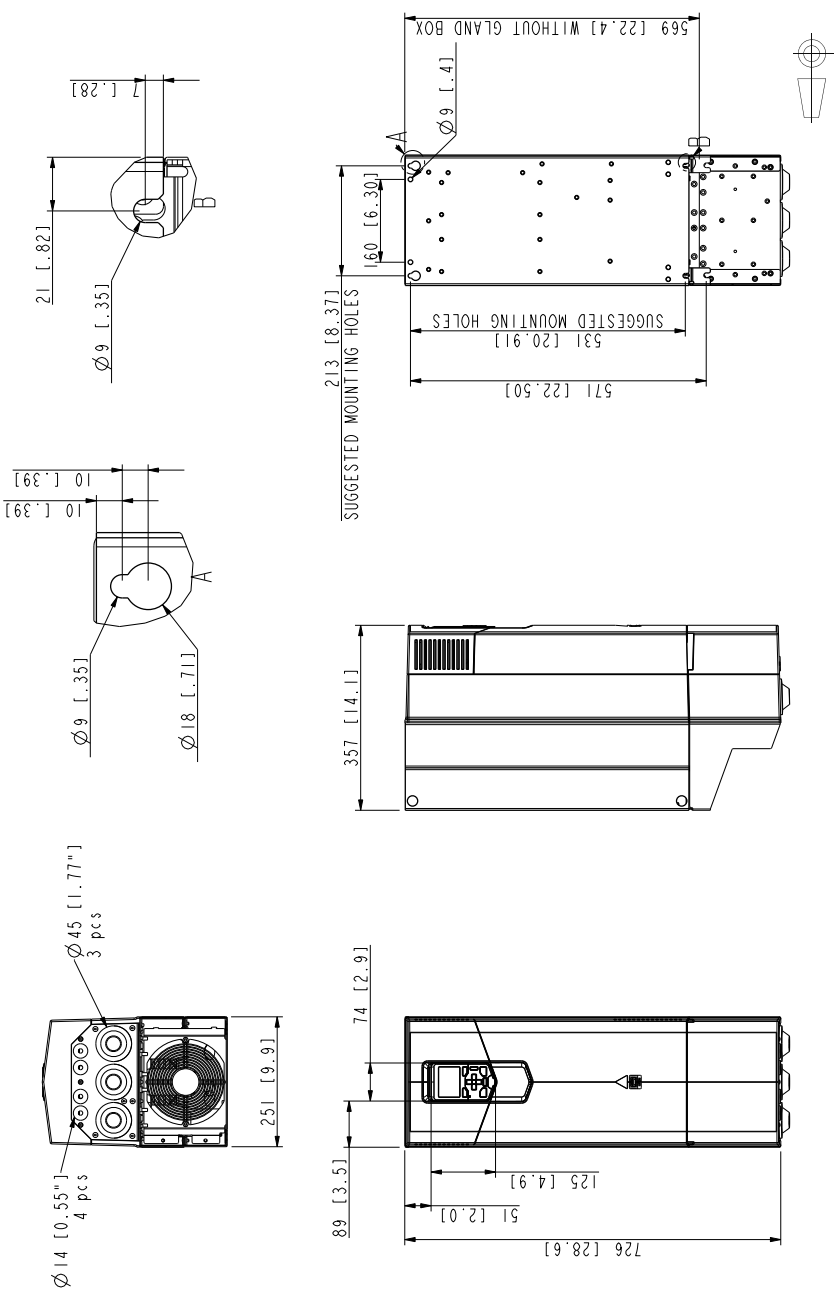
Frame R4 (IP21, UL Type 1)



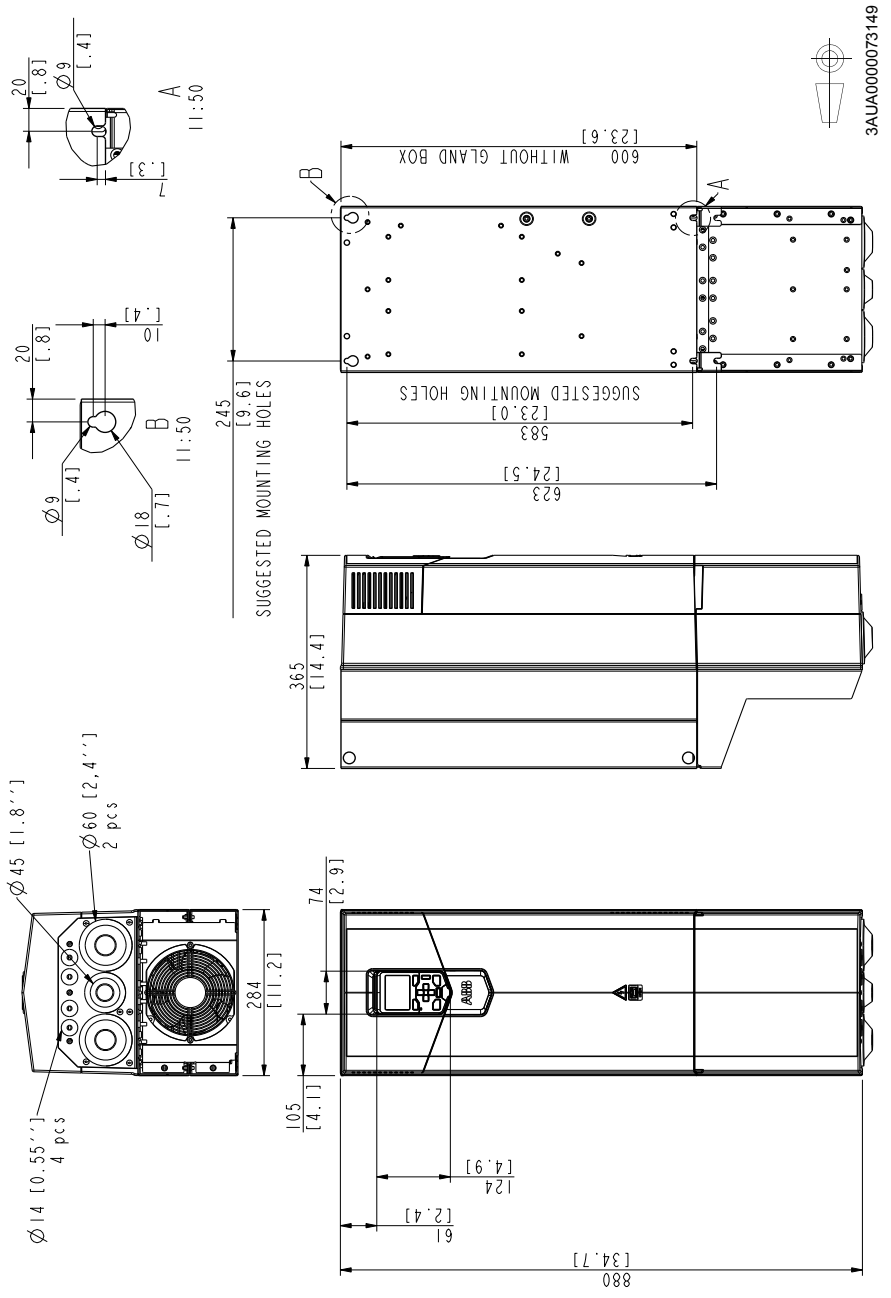
Frame R5 (IP21, UL Type 1)



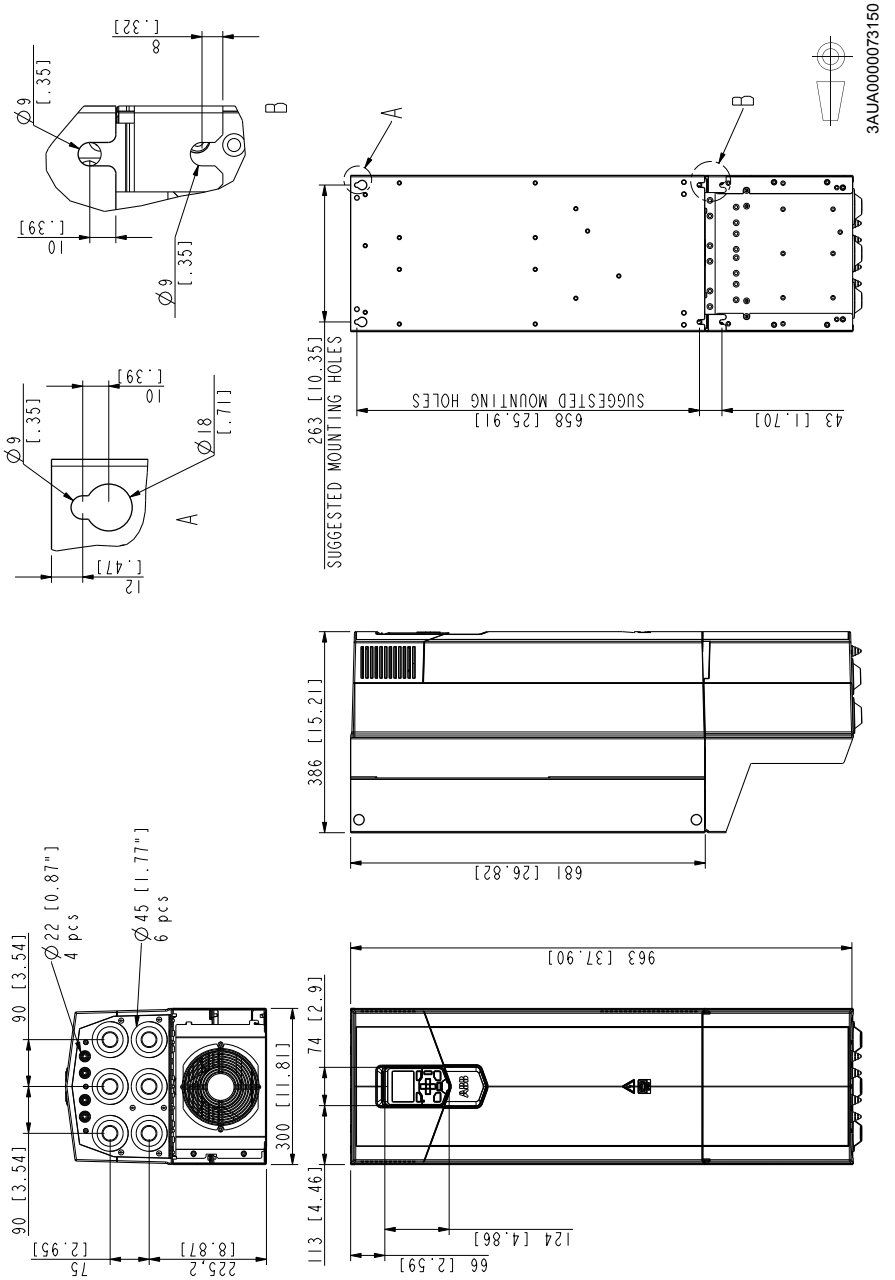
Frame R6 (IP21, UL Type 1)



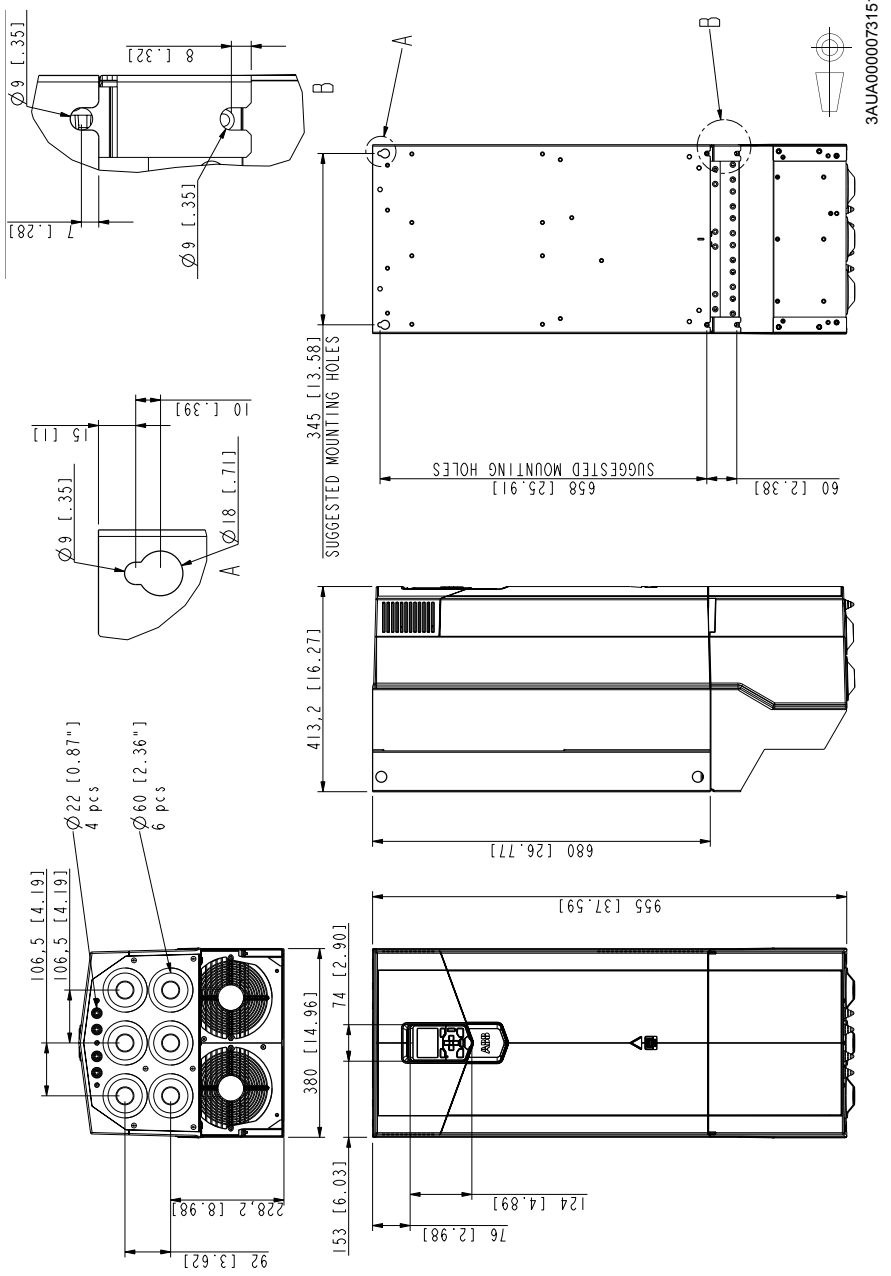
Frame R7 (IP21, UL Type 1)



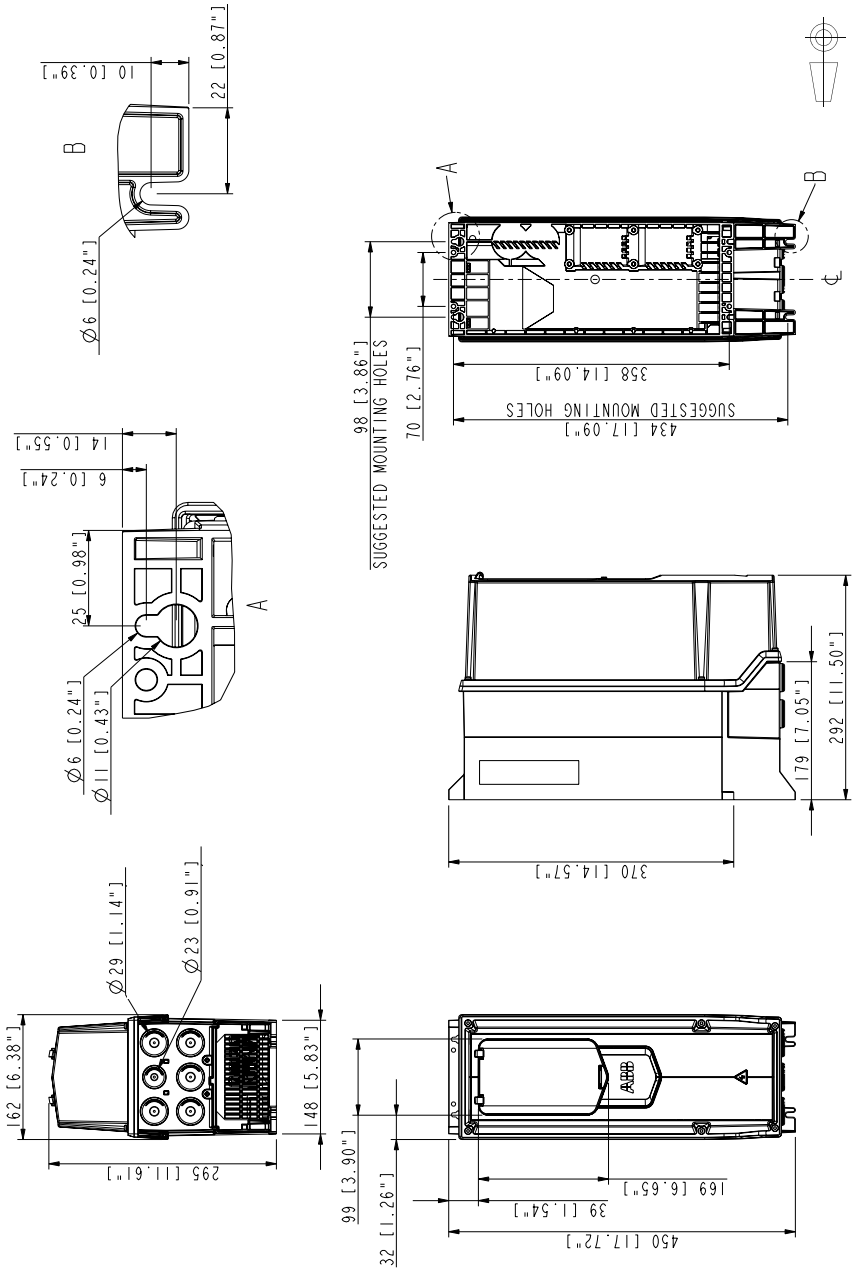
Frame R8 (IP21, UL Type 1)



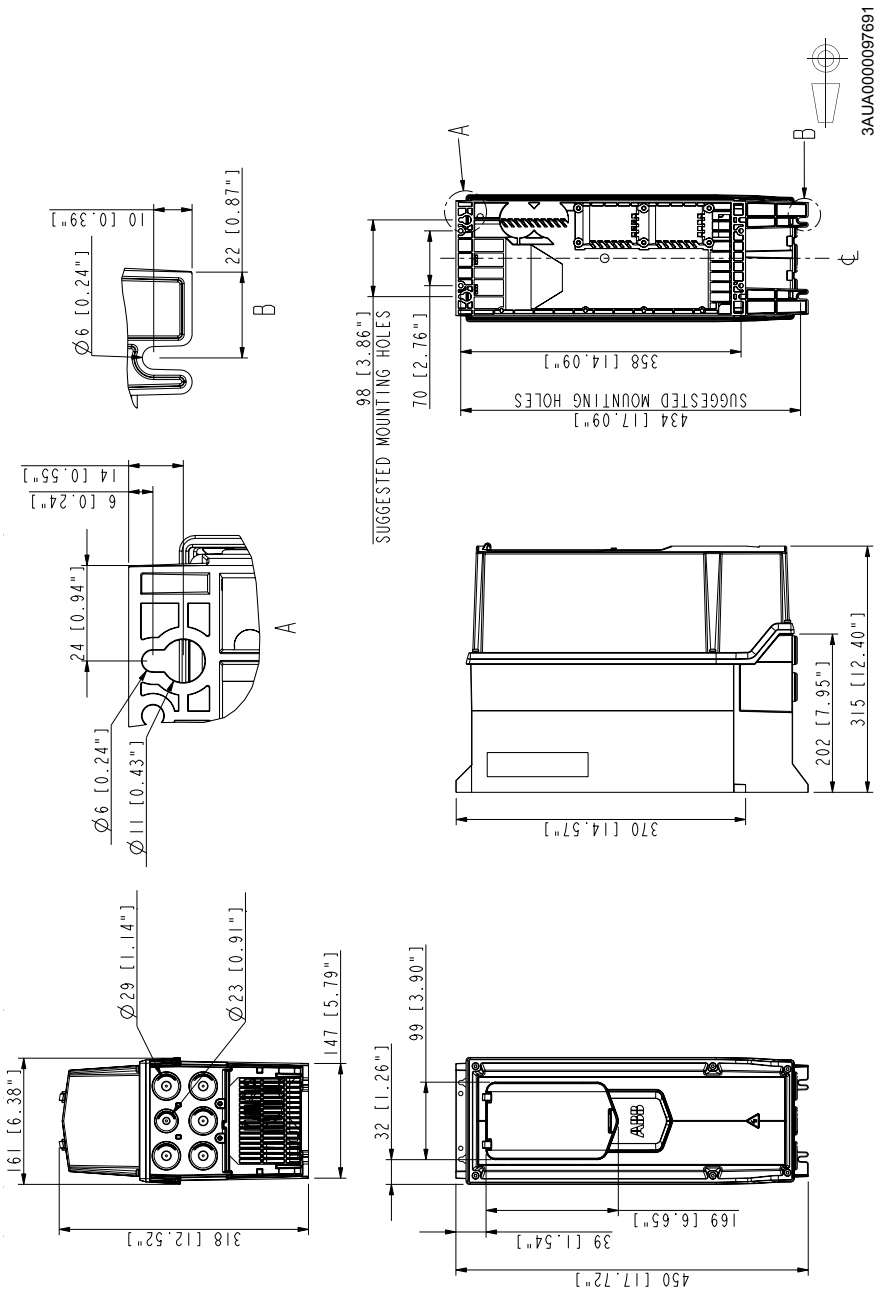
Frame R9 (IP21, UL Type 1)



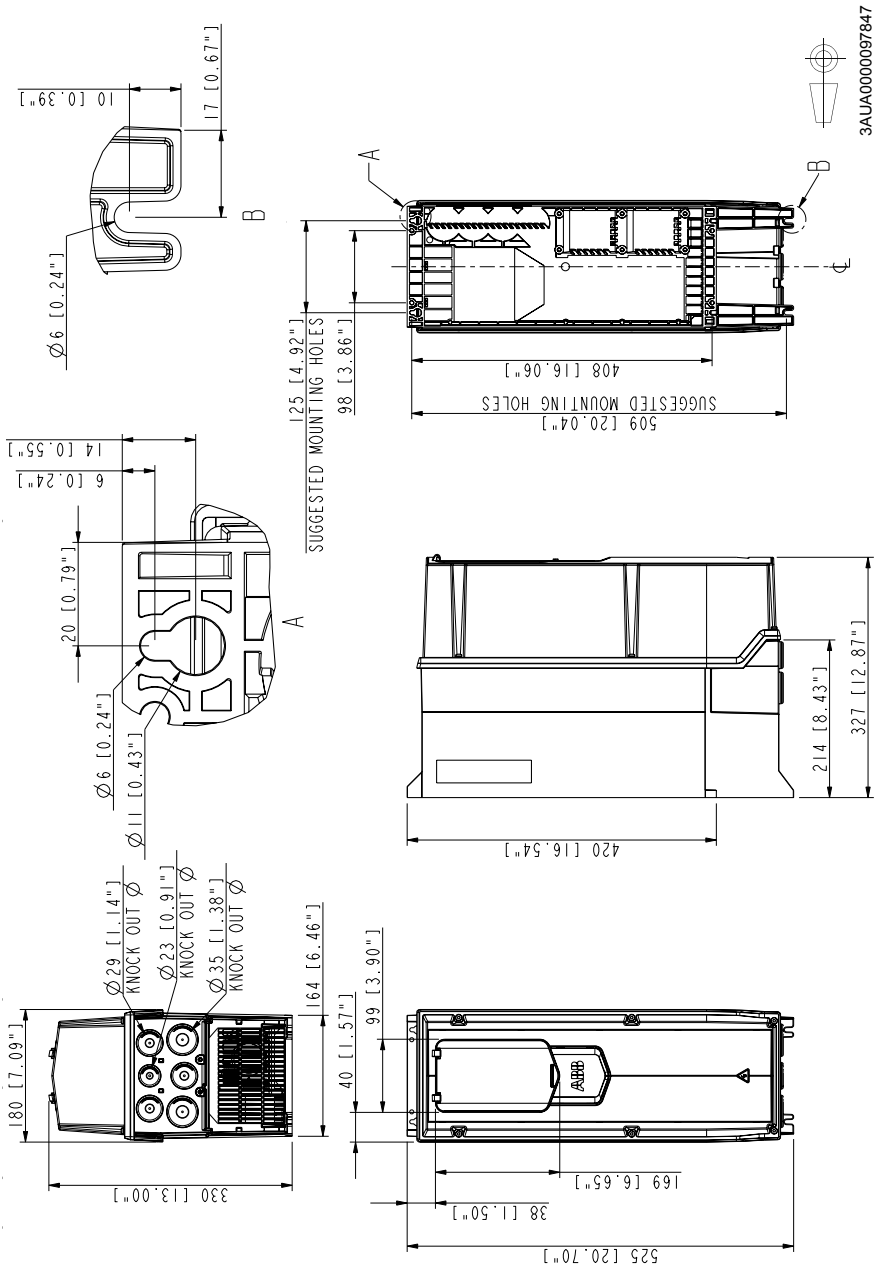
Frame R1 (IP55, UL Type 12)



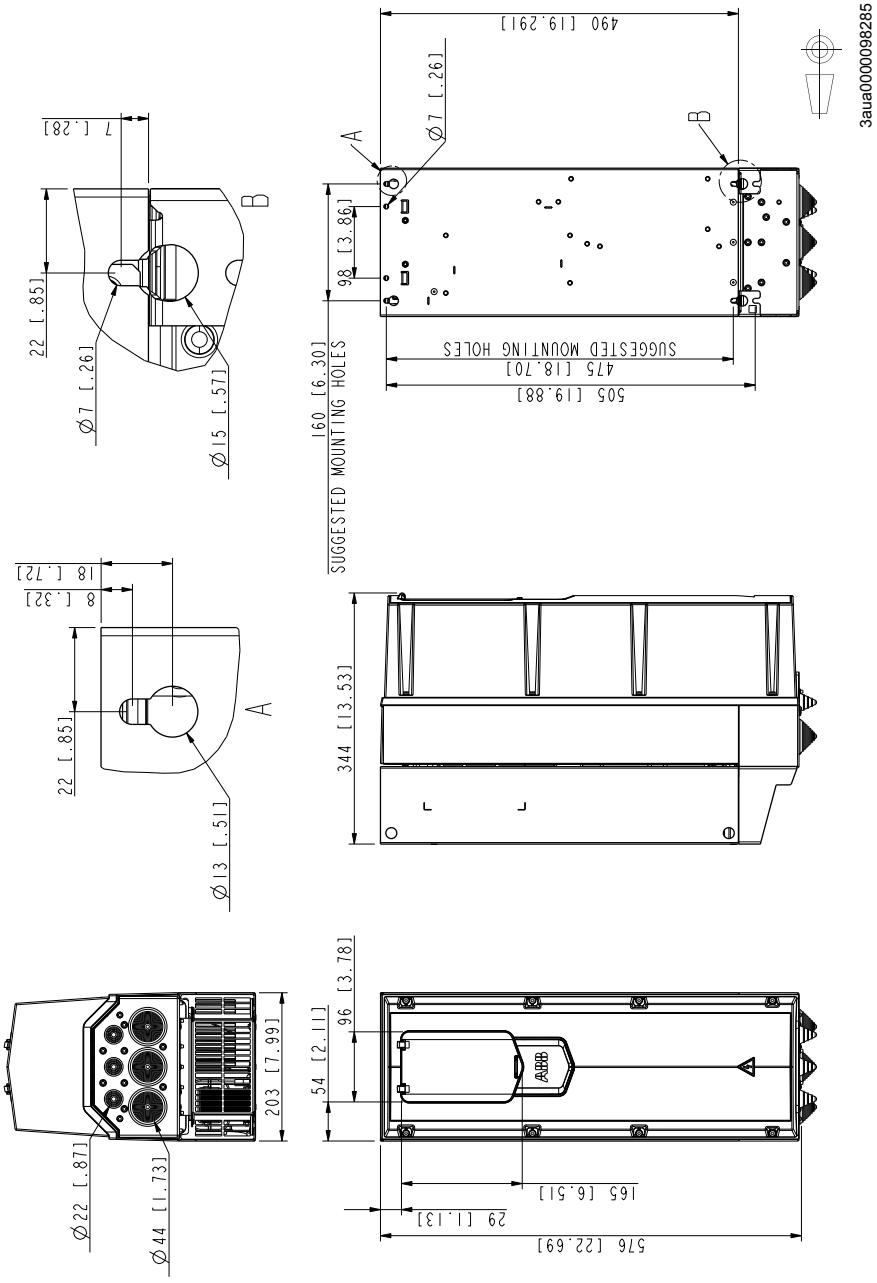
Frame R2 (IP55, UL Type 12)



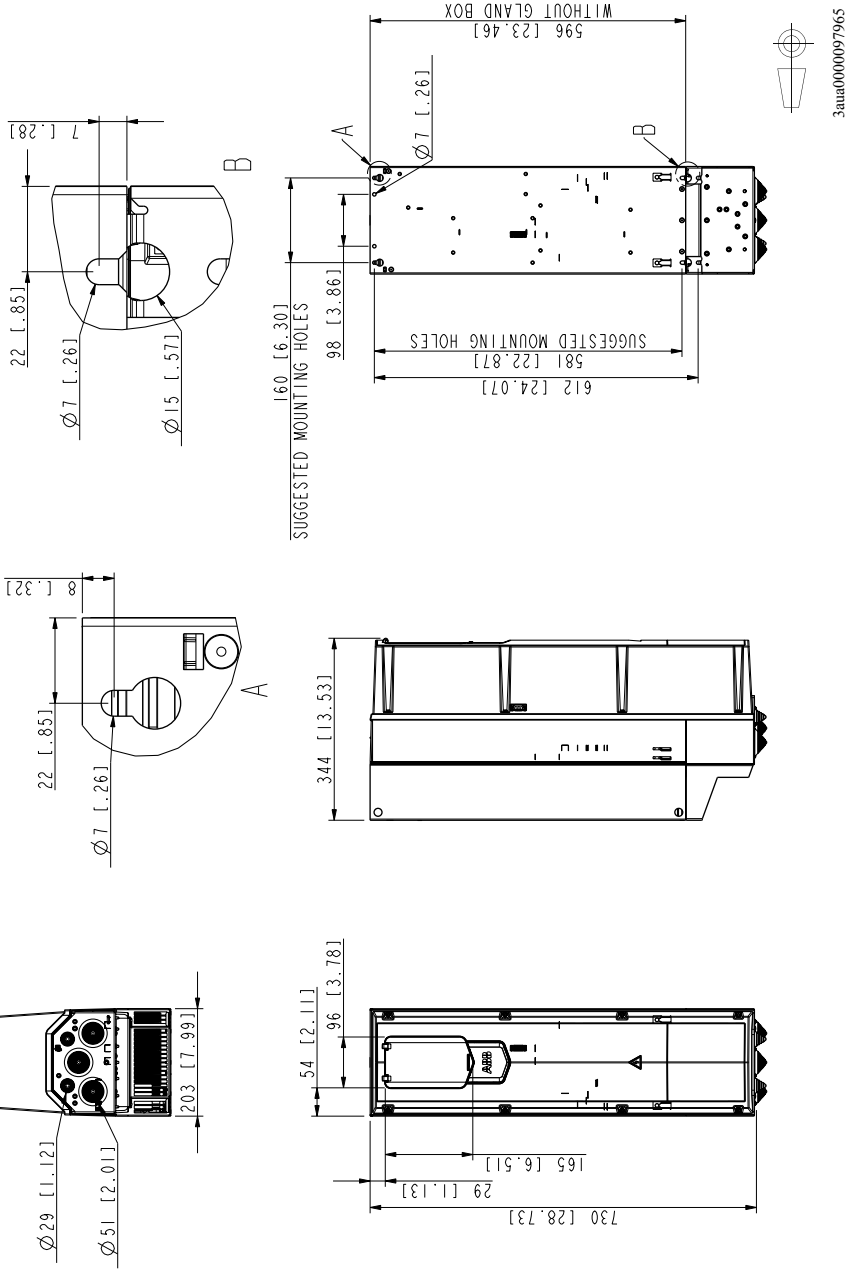
Frame R3 (IP55, UL Type 12)



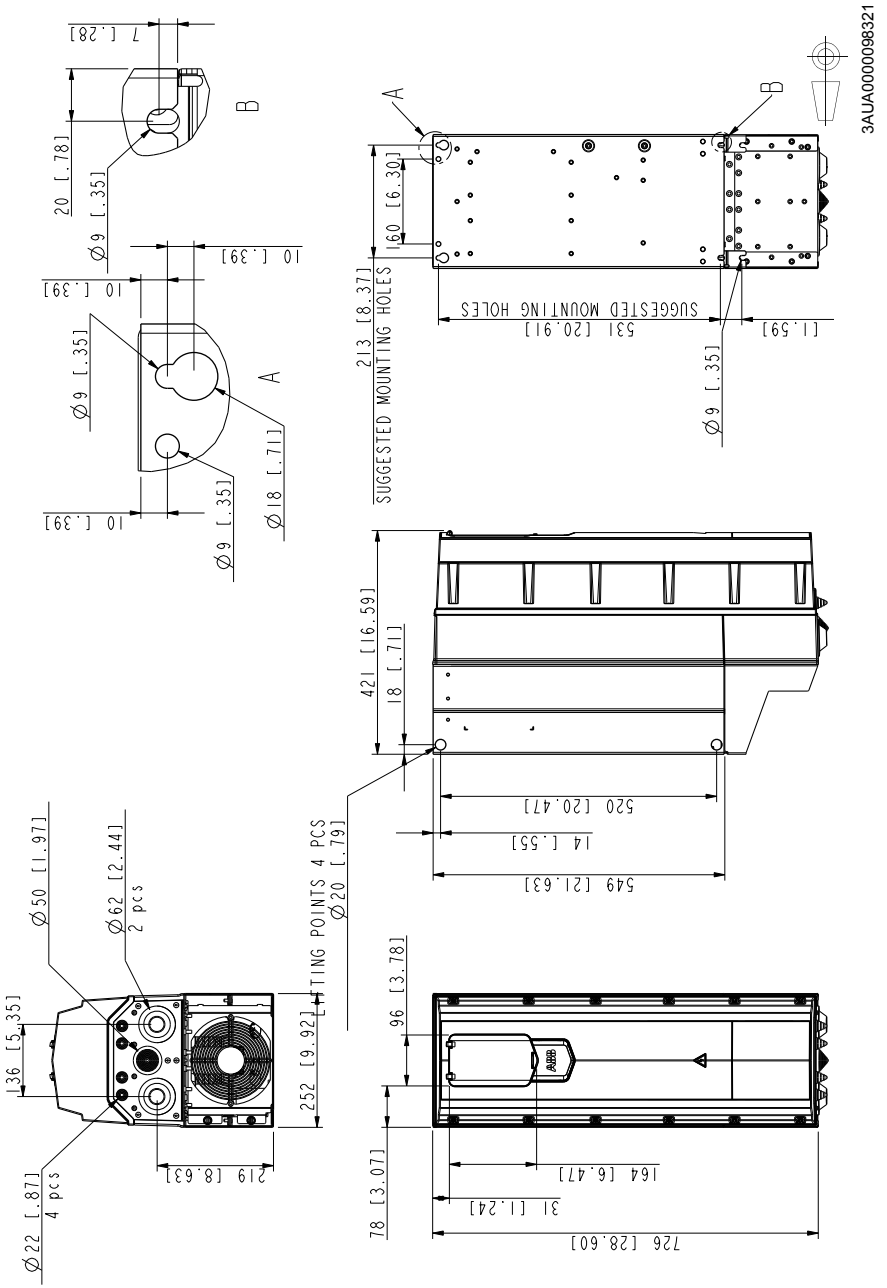
Frame R4 (IP55, UL Type 12)



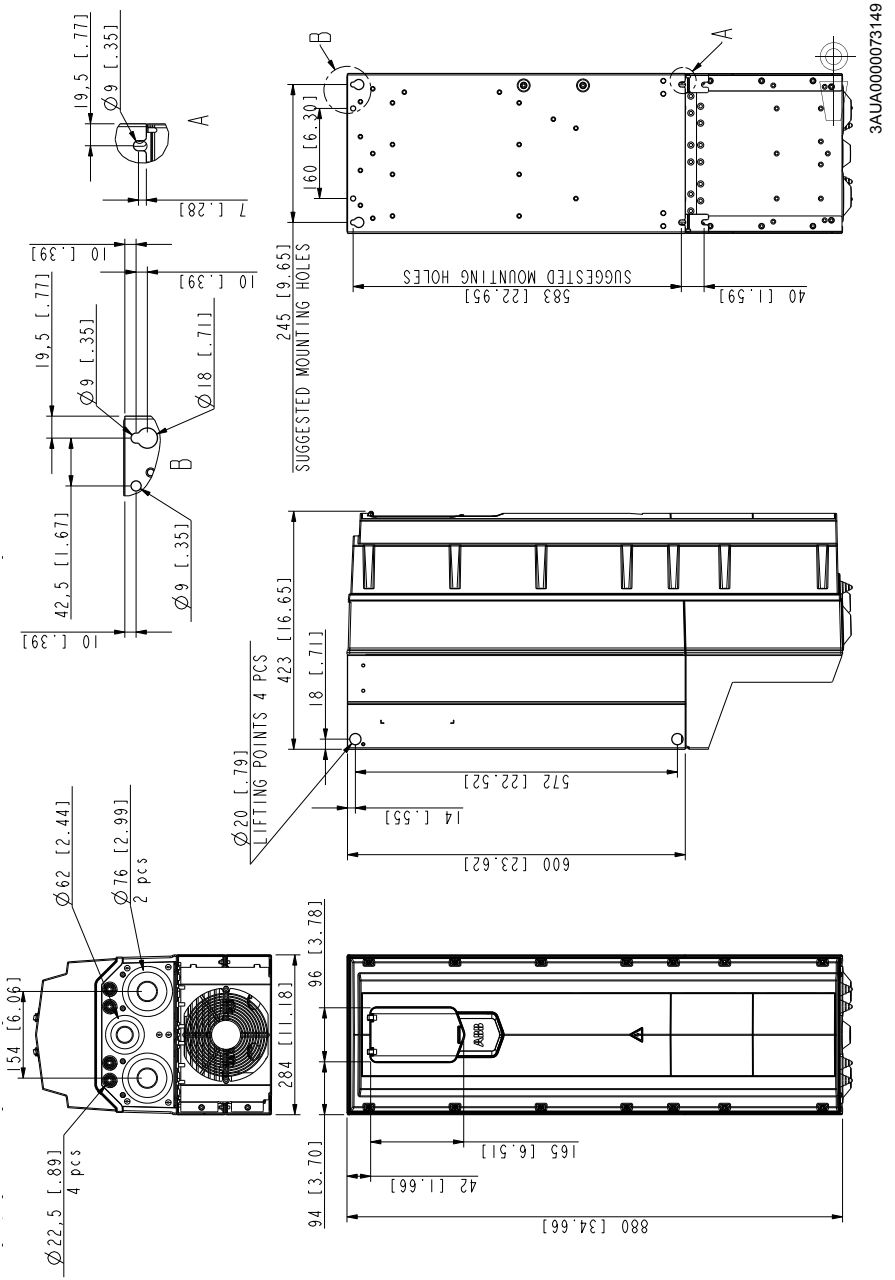
Frame R5 (IP55, UL Type 12)



Frame R6 (IP55, UL Type 12)



Frame R7 (IP55, UL Type 12)



13

Safe Torque off function

What this chapter contains

This chapter describes the Safe torque off function of the drive and gives instructions for its use.

Description

The Safe torque off function can be used, for example, to construct safety or supervision circuits that stop the drive in case of danger (such as an emergency stop circuit). Another possible application is a prevention of unexpected start-up switch that enables short-time maintenance operations like cleaning or work on non-electrical parts of the machinery without switching off the power supply to the drive.

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see diagram below), thus preventing the drive from generating the torque required to rotate the motor. If the motor is running when Safe torque off is activated, it coasts to a stop.

The Safe torque off function has a redundant architecture, that is, both channels must be used in the safety function implementation. The safety data given in this manual is calculated for redundant use, and does not apply if both channels are not used.

The Safe torque off function of the drive complies with

- EN 61800-5-2:2007
- IEC 61508-1, -2:2010
- EN 62061:2005 /AC:2010
- EN ISO 13849-1:2008 /AC:2009
- EN ISO 13849-2:2008
- EN 60204-1:2006 + AC:2010
- IEC 61511:2003
- IEC 61326-3-1:2008.

The function also corresponds to prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and uncontrolled stop (stop category 0) as specified in EN 60204-1:2006 + AC:2010.

Compliance with the European Machinery Directive

See section *Compliance with the European Machinery Directive* on page *163*.

Wiring

The following diagrams show examples of Safe torque off wiring for

- a single drive (page *192*)
- multiple drives (page *193*)
- multiple drives when an external 24 V DC power supply is used (page *194*).

For information on the specifications of the STO input, see section *Control unit/board (ZCU-11/ZCON-11) connection data* on page *157*.

Activation switch

In the wiring diagrams below, the activation switch has the designation (K). This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- If a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- The contacts of the switch or relay must open/close within 200 ms of each other.
- An FSO-xx safety functions module can also be used. For more information, see the FSO-xx module documentation.
- If a safety PLC is used, test pulses longer than 1 ms are not allowed. We recommend a 1…60 s pulse interval.

Cable types and lengths

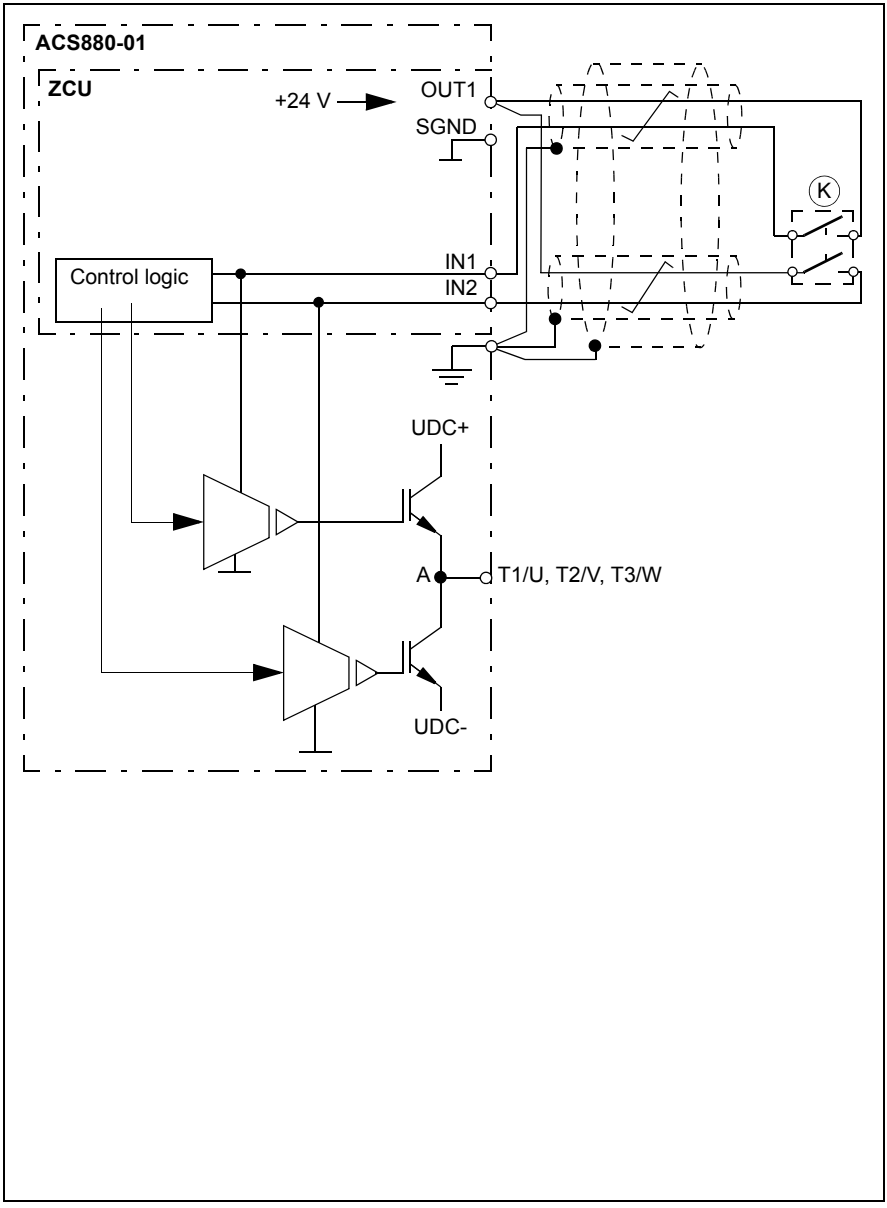
Double-shielded twisted-pair cable is recommended.

Maximum cable lengths:

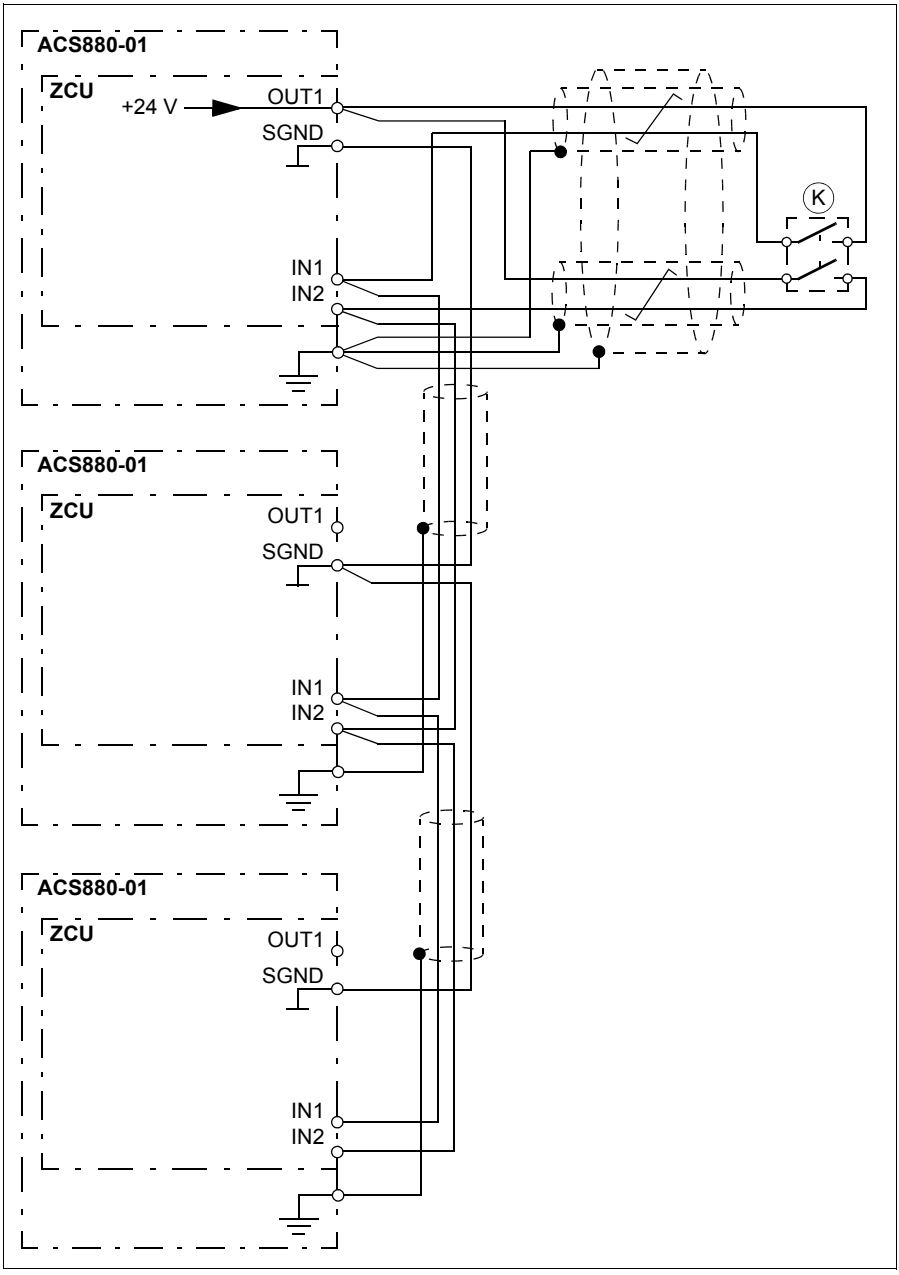
- 30 m (100 ft) between activation switch (K) and drive control unit
- 60 m (200 ft) between multiple drives
- 60 m (200 ft) between external power supply and first drive.

Note that the voltage at the INx terminals of each drive must be at least 17 V DC to be interpreted as “1”.

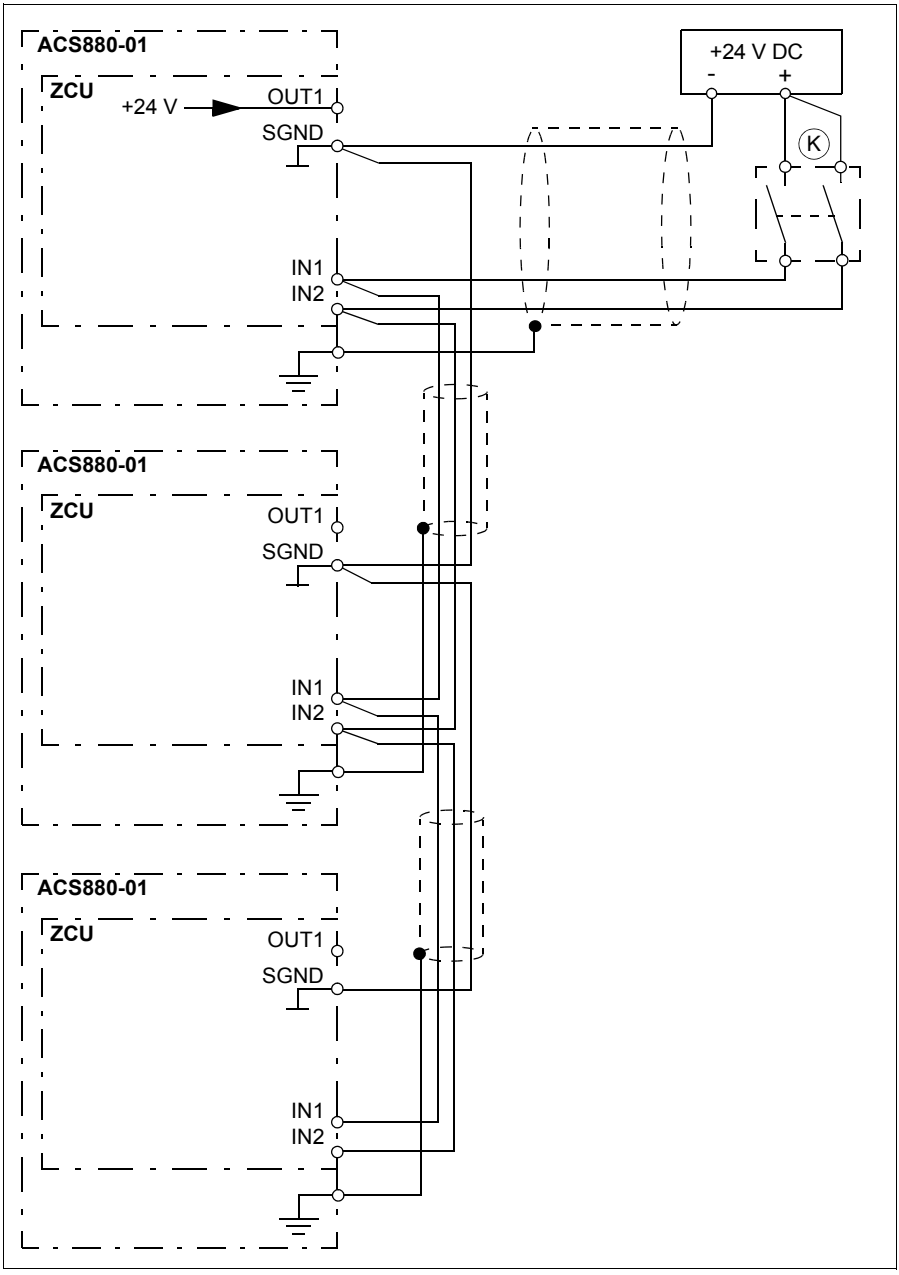
Single drive (internal power supply)



Multiple drives (internal power supply)



Multiple drives (external power supply)



Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. STO inputs on the drive control unit de-energize.
3. The control unit cuts off the control voltage from the drive IGBTs.
4. The control program generates an indication as defined by parameter 31.22 (refer to the firmware manual of the drive).
5. Motor coasts to stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a new start command is required to start the drive.

Start-up including acceptance test

To ensure safe operation of the Safe torque off function, validation is required. The final assembler of the machine must validate the function by performing an acceptance test.

The acceptance test must be performed:

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

Authorized person

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the authorized person.

Acceptance test reports

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance shall be logged into the logbook.

Acceptance test procedure

After wiring the Safe torque off function, validate its operation as follows. Setting of the control program parameters is not needed. If an FSO-xx safety functions module is installed, refer to its documentation.

Action	☑
WARNING! Follow the *Safety instructions*, page *13*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	☐
Ensure that the drive can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	☐
Check the Safe torque off (STO) circuit connections against the circuit diagram.	☐
Close the disconnector and switch the power on.	☐
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Make sure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for 'stopped' state in parameter 31.22 (see the firmware manual). • Give a start command to verify that the STO function blocks the drive operations. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the STO function when the motor is running: • Start the drive and make sure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for 'running' state in parameter 31.22 (see the firmware manual). • Reset any active faults and try to start the drive. • Make sure that the motor stays at standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	☐

Use

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the inverter IGBTs.
3. The control program generates an indication as defined by parameter 31.22 (refer to the firmware manual of the drive).
4. Motor coasts to stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or reseting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.

WARNING! The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive system from the main supply.

WARNING! (With permanent magnet or synchronous reluctance [SynRM] motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* (with permanent magnet motors) or 180/2*p* (with synchronous reluctance [SynRM] motors) degrees regardless of the activation of the Safe torque off function. *p* denotes the number of pole pairs.

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the drive.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.

Maintenance

After the operation of the circuit is verified at start-up, it does not need any maintenance. However, it is a good practice to check the operation of the function when the other maintenance procedures are carried out on the machinery.

Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start up, or the parameters are restored, follow the test given in section *Start-up including acceptance test*, page *195*.

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by drive parameter 31.22.

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an “STO hardware failure” fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

See the drive firmware manual for the indications generated by the drive, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

Any failures of the Safe torque off function must be reported to ABB.

Safety data (SIL, PL)

The safety data for the Safe torque off function is given below.

Note: The safety data is calculated for redundant use, and does not apply if both channels are not used.

Frame	IEC 61508					
	SIL	PFH_d (1/h)	HFT	SFF (%)	T1 (Years)	PFD
U_N = 208…500 V						
R1	3	2.33E-09 (2.33 FIT)	1	99.81	20	4.58E-7
R2	3	2.33E-09 (2.33 FIT)	1	99.81	20	4.58E-7
R3	3	2.33E-09 (2.33 FIT)	1	99.81	20	3.69E-7
R4	3	2.43E-09 (2.43 FIT)	1	99.80	20	5.85E-7
R5	3	2.43E-09 (2.43 FIT)	1	99.80	20	5.85E-7
R6	3	2.44E-09 (2.44 FIT)	1	99.79	20	8.70E-7
R7	3	2.44E-09 (2.44 FIT)	1	99.79	20	8.70E-7
R8	3	3.84E-09 (3.84 FIT)	1	97.03	20	1.56E-4

Frame	IEC 61508					
	SIL	PFH_d (1/h)	HFT	SFF (%)	T1 (Years)	PFD
R9	3	3.84E-09 (3.84 FIT)	1	97.03	20	1.56E-4
U_N = 525…690 V						
R5	3	2.89E-09 (2.89 FIT)	1	94.96	20	7.70E-5
R6…R9	3	3.84E-09 (3.84 FIT)	1	97.03	20	1.56E-4

Frame	EN/ISO 13849-1					IEC 62061	IEC 61511
	PL	CCF (%)	$MTTF_d$ (Years)	DC* (%)	Cat.	SILCL	SIL
U_N = 208…500 V							
R1	e	80	7321	> 90	3	3	3
R2	e	80	7321	> 90	3	3	3
R3	e	80	9093	> 90	3	3	3
R4	e	80	5731	> 90	3	3	3
R5	e	80	5731	> 90	3	3	3
R6	e	80	3846	> 90	3	3	3
R7	e	80	3846	> 90	3	3	3
R8	e	80	1373	> 90	3	3	3
R9	e	80	1373	> 90	3	3	3
U_N = 525…690 V							
R5	e	80	1373	> 90	3	3	3
R6…R9	e	80	1373	> 90	3	3	3

* according to Table E.1 in EN/ISO 13849-1

- This temperature profile is used in the safety value calculations:
  - 670 on/off cycles per year with $\triangle T$ = 71.66 °C
  - 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
  - 30 on/off cycles per year with $\triangle T$ = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.
- The STO is a type A safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested

  A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.

- STO reaction time (shortest detectable break): 1 ms
- STO response time: 2 ms (typical), 5 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time + 10 ms
- STO fault indication (parameter 31.22) delay: < 500 ms
- STO warning indication (parameter 31.22) delay: < 1000 ms

Certificate

TÜV NORD

Certificate

No. SLA-0055/10, V. 1.1

TÜV NORD Systems GmbH & Co. KG hereby certifies

ABB Oy
Hiomotie 13
FI-00381 Helsinki
Finland

that the realization of the safety function "Safe Torque Off - STO"
in the ABB industrial drives series

Type ACS880

are capable for safety related applications up to SIL 3, SILcl 3 and PL e and meet the requirements listed in the following standards

- IEC 61508 part 1:2010; part 2:2010; capable up to SIL 3
- ISO 13849-1:2006, ISO 13849-2:2003; capable up to PL e (category 3)
- IEC 62061:2005; capable up to $SIL_{CL}3$
- IEC 61800-5-2:2007; capable up to SIL 3

The drive series can also be used in safety applications up to SIL 3 according to IEC 61511

The released versions of the certified ACS880 drives are given in the "tracking-list for released versions of the certified ACS880 drives". This list is an add-on to this certificate.

The certification is based on the reports in the valid version, referenced in the "tracking-list". This certificate entitles the holder to use the pictured "Safety Approved" mark.

Expiry date: 2017-06-04
Reference No: G.SEB.BS.02.021.02.031

Gerhard M. Rieger
Augsburg, 2012-11-09

TÜV NORD Systems GmbH & Co. KG, Branch South, Halderstr. 27, 86150 Augsburg, Germany

14

Resistor braking

What this chapter contains

This chapter describes how to select, protect and wire brake choppers and resistors. The chapter also contains technical data.

Operation principle and hardware description

Frames R1 to R4 have a built-in brake chopper as standard. Frames R5 and up can be equipped with optional built-in brake chopper (+D150). Brake resistors are available as add-on kits.

The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Planning the braking system

Selecting the brake circuit components

1. Calculate the maximum power generated by the motor during braking (P_{max}).
2. Select a suitable drive, brake chopper and brake resistor combination for the application from the rating table on page *209*. The braking power of the chopper must be greater or equal than the maximum power generated by the motor during the braking.

Note: A custom resistor can be selected within the limits imposed by the internal brake chopper of the drive:

- The resistance value of the custom resistor is at least R_{min}. The braking power capacity of the resistor can be calculated from the following equation:

$$P_{max} < \frac{U_{DC}^2}{R}$$

where

P_{max}	Maximum power generated by the motor during braking
U_{DC}	Voltage over the resistor during braking. U_{DC} equals to 1.35 · 1.25 · 240 V DC (when supply voltage is 208 to 240 V AC) 1.35 · 1.25 · 415 V DC (when supply voltage is 380 to 415 V AC) 1.35 · 1.25 · 500 V DC (when supply voltage is 440 to 500 V AC) or 1.35 · 1.25 · 690 V DC (when supply voltage is 525 to 690 AC)
R	Resistor resistance (ohm)

WARNING! Never use a brake resistor with a resistance below the value specified for the particular drive / brake chopper / resistor combination. The drive and the chopper are not able to handle the overcurrent caused by the low resistance.

3. Check the resistor selection. The energy generated by the motor during a 400-second period must not exceed the resistor heat dissipation capacity E_R.

Note: If the E_R value is not sufficient, it is possible to use a four-resistor assembly in which two standard resistors are connected in parallel, two in series. The E_R value of the four-resistor assembly is four times the value specified for the standard resistor.

Selecting and routing the brake resistor cables

Use the same cable type for the resistor cabling as for the drive input cabling to ensure that the input fuses also protect the resistor cable. Alternatively, a two conductor shielded cable with the same cross-sectional area can be used.

Minimizing electromagnetic interference

Follow these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:

- Shield the braking power line completely, either by using shielded cable or a metallic enclosure. Unshielded single-core cable can only be used if it is routed inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters.
- Cross the other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length

The maximum length of the resistor cable(s) is 10 m (33 ft).

EMC compliance of the complete installation

Note: ABB has not verified that the EMC requirements are fulfilled with external user-defined brake resistors and cabling. The EMC compliance of the complete installation must be considered by the customer.

Placing the brake resistors

Install the resistors outside the drive in a place where they will cool.

Arrange the cooling of the resistor in a way that:

- no danger of overheating is caused to the resistor or nearby materials
- the temperature of the room the resistor is located in does not exceed the allowed maximum.

Supply the resistor with cooling air/water according to the resistor manufacturer's instructions.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the material withstands high temperatures. Protect the resistor against contact.

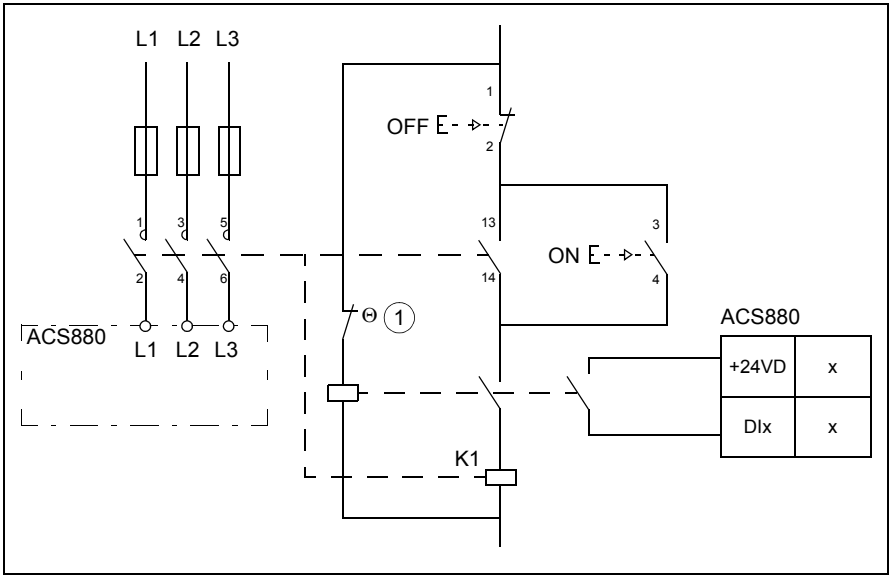
Protecting the system against thermal overload

The brake chopper protects itself and the resistor cables against thermal overload when the cables are dimensioned according to the nominal current of the drive. The drive control program includes a resistor and resistor cable thermal protection function which can be tuned by the user. See the firmware manual.

Frames R1 to R4

Equipping the drive with a main contactor is highly recommended for safety reasons. Wire the contactor so that it opens in case the resistor overheats. This is essential for safety since the drive will not otherwise be able to interrupt the main supply if the chopper remains conductive in a fault situation. An example wiring diagram is shown below. ABB resistors are equipped with a thermal switch (1) inside the resistor assembly as standard. The switch indicates overtemperature and overload.

We recommend that you also wire the thermal switch to a digital input ot the drive.

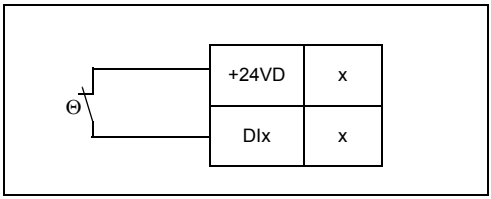


Frames R5 to R9

A main contactor is not required for protecting against resistor overheating when the resistor is dimensioned according to the instructions and the internal brake chopper is in use. The drive will disable power flow through the input bridge if the chopper remains conductive in a fault situation but the charging resistor may fail.

Note: If an external brake chopper (outside the drive module) is used, a main contactor is always required.

A thermal switch (standard in ABB resistors) is required for safety reasons. The thermal switch cable must be shielded and may not be longer than the resistor cable. Wire the switch to a digital input on the drive control unit as shown in the figure below.



Protecting the resistor cable against short-circuits

The input fuses will also protect the resistor cable when it is identical with the input cable.

Mechanical installation

All brake resistors must be installed outside the drive. Follow the resistor manufacturer's instructions.

Electrical installation

Checking the insulation of the assembly

Follow the instructions given under *Brake resistor assembly* on page *80*.

Connection diagram

See section *Connection diagram* on page *82*.

Connection procedure

- Connect the resistor cables to the R+ and R- terminals in the same way as the other power cables. If a shielded three-conductor cable is used, cut the third conductor and ground the twisted shield of the cable (protective earth conductor of the resistor assembly) at both ends.
- Connect the thermal switch of the brake resistor as described above in section *Frames R1 to R4* or *Frames R5 to R9*.

Start-up

Set the following parameters (ACS880 primary control program):

- Disable the overvoltage control of the drive by parameter **30.30 Overvoltage control**.
- Set parameter **31.01 External event 1 source** to point to the digital input where the thermal switch of the brake resistor is wired.
- Set parameter **31.02 External event 1 type** to **Fault**.
- Enable the brake chopper by parameter **43.06 Brake chopper enable**. If **Enabled with thermal model** is selected, set also the brake resistor overload protection parameters 43.08 and 43.09 according to the application.
- For frames R5 to R9: Set parameter **43.07 Brake chopper runtime enable** to **Other [bit]** and select from parameter **10.01 DI status** the digital input where the thermal switch of the brake resistor is wired.
- Check the resistance value of parameter **43.10 Brake resistance**.

With these parameter settings, the drive stops by coasting on brake resistor overtemperature.

WARNING! If the drive is equipped with a brake chopper but the chopper is not enabled by the parameter setting, the internal thermal protection of the drive against resistor overheating is not in use. In this case, the brake resistor must be disconnected.

For settings of other control programs, see the appropriate firmware manual.

Technical data

Ratings

Drive type	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_N = 208…240 V						
ACS880-01-04A6-2	0.75	180	2×JBR-01*	240	44	0.21
ACS880-01-06A6-2	1.1	180	2×JBR-01*	240	44	0.21
ACS880-01-07A5-2	1.5	65	JBR-03	80	40	0.14
ACS880-01-10A6-2	2.2	65	JBR-03	80	40	0.14
ACS880-01-16A8-2	4.0	18	SACE15RE22	22	420	2
ACS880-01-24A3-2	5.5	18	SACE15RE22	22	420	2
ACS880-01-031A-2	7.5	13	2×SAFUR90F575*	16	3600	9
U_N = 380…415 V						
ACS880-01-02A4-3	0.75	210	2×JBR-01*	240	44	0.21
ACS880-01-03A3-3	1.1	210	2×JBR-01*	240	44	0.21
ACS880-01-04A0-3	1.5	210	2×JBR-01*	240	44	0.21
ACS880-01-05A6-3	2.2	210	2×JBR-01*	240	44	0.21
ACS880-01-07A2-3	3.0	78	JBR-03	80	40	0.14
ACS880-01-09A4-3	4.0	78	JBR-03	80	40	0.14
ACS880-01-12A6-3	5.5	78	JBR-03	80	40	0.14
ACS880-01-017A-3	7.5	39	SACE08RE44	44	210	1
ACS880-01-025A-3	11	39	SACE08RE44	44	210	1
ACS880-01-032A-3	15	19	SACE15RE22	22	420	2
ACS880-01-038A-3	18.5	19	SACE15RE22	22	420	2
ACS880-01-045A-3	22	13	2×SAFUR90F575*	16	3600	9
ACS880-01-061A-3	30	13	2×SAFUR90F575*	16	3600	9
ACS880-01-072A-3	37	8	SAFUR90F575	8	1800	4.5
ACS880-01-087A-3	45	8	SAFUR90F575	8	1800	4.5
ACS880-01-105A-3	55	5.4	SAFUR80F500	6	2400	6
ACS880-01-145A-3	75	5.4	SAFUR80F500	6	2400	6
ACS880-01-169A-3	90	3.3	SAFUR125F500	4	3600	9
ACS880-01-206A-3	110	3	SAFUR125F500	4	3600	9
ACS880-01-246A-3	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-01-293A-3	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-01-363A-3	160	1.5	2×SAFUR210F575**	1.7	8400	21
ACS880-01-430A-3	160	1.5	2×SAFUR210F575**	1.7	8400	21

Drive type	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_N = 380…500 V						
ACS880-01-02A1-5	0.75	210	2×JBR-01*	240	44	0.21
ACS880-01-03A0-5	1.1	210	2×JBR-01*	240	44	0.21
ACS880-01-03A4-5	1.5	210	2×JBR-01*	240	44	0.21
ACS880-01-04A8-5	2.2	210	2×JBR-01*	240	44	0.21
ACS880-01-05A2-5	3.0	78	JBR-03	80	40	0.14
ACS880-01-07A6-5	4.0	78	JBR-03	80	40	0.14
ACS880-01-11A0-5	5.5	78	JBR-03	80	40	0.14
ACS880-01-014A-5	7.5	39	SACE08RE44	44	210	1
ACS880-01-021A-5	11	39	SACE08RE44	44	210	1
ACS880-01-027A-5	15	19	SACE15RE22	22	420	2
ACS880-01-034A-5	18.5	19	SACE15RE22	22	420	2
ACS880-01-040A-5	22	13	2×SAFUR90F575*	16	3600	9
ACS880-01-052A-5	22	13	2×SAFUR90F575*	16	3600	9
ACS880-01-065A-5	37	8	SAFUR90F575	8	1800	4.5
ACS880-01-077A-5	45	8	SAFUR90F575	8	1800	4.5
ACS880-01-096A-5	55	5.4	SAFUR80F500	6	2400	6
ACS880-01-124A-5	75	5.4	SAFUR80F500	6	2400	6
ACS880-01-156A-5	90	3	SAFUR125F500	4	3600	9
ACS880-01-180A-5	110	3.3	SAFUR125F500	4	3600	9
ACS880-01-240A-5	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-01-260A-5	132	2.3	SAFUR200F500	2.7	5400	13.5
ACS880-01-302A-5	160	1.5	2×SAFUR210F575**	1.7	8400	21
ACS880-01-361A-5	160	1.5	2×SAFUR210F575**	1.7	8400	21
ACS880-01-414A-5	160	1.5	2×SAFUR210F575**	1.7	8400	21

Drive type	Internal brake chopper		Example brake resistor(s)			
	P_{brcont}	R_{min}	Type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_N = 525…690 V						
ACS880-01-07A3-7	***	***	2×JBR-01*	240	44	0.21
ACS880-01-09A8-7	***	***	2×JBR-01*	240	44	0.21
ACS880-01-14A2-7	***	***	SACE15RE22	22	420	2
ACS880-01-018A-7	***	***	SACE15RE22	22	420	2
ACS880-01-022A-7	***	***	SACE15RE22	22	420	2
ACS880-01-026A-7	***	***	SACE15RE22	22	420	2
ACS880-01-035A-7	***	***	SACE15RE22	22	420	2
ACS880-01-042A-7	***	***	SACE15RE22	22	420	2
ACS880-01-049A-7	***	***	SACE15RE22	22	420	2
ACS880-01-061A-7	55	13	2×SAFUR90F575*	16	3600	9
ACS880-01-084A-7	65	13	2×SAFUR90F575*	16	3600	9
ACS880-01-098A-7	90	8	SAFUR90F575	8	1800	4.5
ACS880-01-119A-7	110	8	SAFUR90F575	8	1800	4.5
ACS880-01-142A-7	132	6	SAFUR80F500	6	2400	6
ACS880-01-174A-7	160	6	SAFUR80F500	6	2400	6
ACS880-01-210A-7	200	4	SAFUR125F500	4	3600	9
ACS880-01-271A-7	250	4	SAFUR125F500	4	3600	9

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P_{brcont} The internal brake chopper will withstand this continuous braking power.
R_{min} The minimum allowed resistance value of the brake resistor
R Resistance value for the listed resistor assembly
E_R Short energy pulse that the resistor assembly withstands every 400 seconds
P_{Rcont} Continuous power (heat) dissipation of the resistor when placed correctly
* Connected in series
** Connected in parallel
*** Contact ABB for P_{brcont} and R_{min}.
The rating apply at an ambient temperature of 40 °C (104 °F)

Degree of protection of JBR, SACE and SAFUR resistors

JBR	IP20
SACE	IP21
SAFUR	IP00

Terminals and cable lead-through data

See section *Terminal and lead-through data for the power cables* on page *153*.

15

Common mode, du/dt and sine filters

What this chapter contains

This chapter describes how to select external filters for the drive.

Common mode filters

When is a common mode filter needed?

See section *Checking the compatibility of the motor and drive*, page *52*. A common mode filter kit is available from ABB with order number is 64315811 for the drive. The kit includes three wound cores. For installation instructions of the cores, see the instruction included in the core package.

du/dt filters

When is a du/dt filter needed?

See section *Checking the compatibility of the motor and drive*, page *52*.

du/dt filter types

Drive type ACS880-01-	du/dt filter type	Drive type ACS880-01-	du/dt filter type	Drive type ACS880-01-	du/dt filter type
U_N = 380…415 V		U_N = 500 V		U_N = 525…690 V	
02A4-3	NOCH0016-6X	02A1-5	NOCH0016-6X	07A3-7	NOCH0016-6X
03A3-3	NOCH0016-6X	03A0-5	NOCH0016-6X	09A8-7	NOCH0016-6X
04A0-3	NOCH0016-6X	03A4-5	NOCH0016-6X	14A2-7	NOCH0016-6X
05A6-3	NOCH0016-6X	04A8-5	NOCH0016-6X	018A-7	NOCH0030-6X
07A2-3	NOCH0016-6X	05A2-5	NOCH0016-6X	022A-7	NOCH0030-6X
09A4-3	NOCH0016-6X	07A6-5	NOCH0016-6X	026A-7	NOCH0030-6X
12A6-3	NOCH0016-6X	11A0-5	NOCH0016-6X	035A-7	NOCH0070-6X
017A-3	NOCH0016-6X	014A-5	NOCH0016-6X	042A-7	NOCH0070-6X
025A-3	NOCH0030-6X	021A-5	NOCH0030-6X	049A-7	NOCH0070-6X
032A-3	NOCH0070-6X	027A-5	NOCH0070-6X	061A-7	NOCH0120-6X
038A-3	NOCH0070-6X	034A-5	NOCH0070-6X	084A-7	NOCH0120-6X
045A-3	NOCH0070-6X	040A-5	NOCH0070-6X	098A-7	NOCH0120-6X
061A-3	NOCH0070-6X	052A-5	NOCH0070-6X	119A-7	FOCH0260-70
072A-3	NOCH0070-6X	065A-5	NOCH0070-6X	142A-7	FOCH0260-70
087A-3	NOCH0120-6X	077A-5	NOCH0120-6X	174A-7	FOCH0260-70
105A-3	NOCH0120-6X	096A-5	NOCH0120-6X	210A-7	FOCH0260-70
145A-3	FOCH0260-70	124A-5	FOCH0260-70	271A-7	FOCH0260-70
169A-3	FOCH0260-70	156A-5	FOCH0260-70	-	-
206A-3	FOCH0260-70	180A-5	FOCH0260-70	-	-
246A-3	FOCH0260-70	240A-5	FOCH0260-70	-	-
293A-3	FOCH0260-70	260A-5	FOCH0260-70	-	-
315A-3	FOCH0320-50	302A-5	FOCH0320-50	-	-
363A-3	FOCH0320-50	361A-5	FOCH0320-50	-	-
430A-3	FOCH0320-50	414A-5	FOCH0320-51	-	-

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Description, installation and technical data of the FOCH filters

See *FOCH du/dt filters hardware manual* (3AFE68577519 [English]).

Description, installation and technical data of the NOCH filters

See *AOCH and NOCH du/dt filters hardware manual* (3AFE58933368 [English]).

Sine filters

Contact your local ABB representative for more information.

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/drives and selecting *Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

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